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Technical Report MM-432
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THEORETICAL PERFORMANCE OF THE ARCAS AND BOOSTED ARCAS

PREPARED BY

MISSILE METEOROLOGY DIVISION

U.S. ARMY
SIGNAL MISSILE SUPPORT AGENCY
WHITE SANDS MISSILE RANGE
NEW MEXICO

HEADQUARTERS
U. S. ARMY SIGNAL MISSILE SUPPORT AGENCY
WHITE SANDS MISSILE RANGE
NEW MEXICO

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THEORETICAL PERFORMANCE OF THE ARCAS AND BOOSTED ARCAS

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ABSTRACT

Trajectory and wind-effect computations, based on the two-dimensional equations of motion for an unguided rocket, were run on the Philco-2000 for the Arcas rocket. Gross launch weights of 73, 75, 77, and 79 pounds for a range of launcher exit velocities from 120 to 175 ft/sec and 75, 77, and 79 pounds for velocities from 200 to 310 ft/sec were used for launch altitudes of sea level and 4000 feet. Similar calculations were made for the Boosted Arcas and included a payload range from 4 to 12 pounds. For sea-level launches, maximum altitudes vary from 36.6 to 41.9 miles depending on payload, quadrant elevation and exit velocities. Values for both the Arcas and Boosted Arcas are presented in tabular and graphic form.

The technique for determining the variation of trajectory and wind effect values has been improved to such an extent that the values derived earlier and published in the previous Arcas report are no longer considered valid.

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I N T R O D U C T I O N

The effect of a given atmospheric condition on the trajectory of a particular rocket is a function of the velocity, stability and total time of flight of the vehicle. Theoretical evaluations and test firings of the Arcas substantiate the need for calculations of rocket displacement due to the wind to assure safe impacts. (1)

To avoid scheduling delays it is desirable to have a collection of wind calculations available to provide for any anticipated launch velocity and launch weight. The development of a new launch technique, utilizing a gas generator, has increased the range of possible launch velocities and necessitates a revision of the previously published Arcas performance report (2) which contained this information for the previously anticipated ranges. This report also contains the theoretical performance of the Boosted Arcas which is a Standard Arcas plus a 33-pound booster which burns one second, giving an average thrust of 2200 pounds. The Arcas rocket burns during the boost phase with a 50 percent effective thrust during boost.

D I S C U S S I O N

The gross launch weight of the Arcas varies depending upon the particular nose-cone payload required for the experiment. The launcher exit velocity may also be varied by use of the gas generator at launch. It is not feasible to calculate trajectories and wind effect for all possible combinations of launch weight and launcher exit velocity; however, if values are obtained for a sufficient number of properly chosen combinations, then the parametric information for any desired combination can be determined by interpolation. For this purpose, computations have been made for gross launch weights of 73, 75, 77, and 79 pounds for each of three launcher exit velocities (120, 150, and 175 feet/second), for gross launch weights of 75, 77, and 79 pounds with a range in launch velocities from 200 to 310 feet/second, and for the boosted Arcas with a payload range of 4 to 12 pounds.

Because the performance of a rocket is a function of the atmosphere, and since the atmospheric density decreases with altitude, both sea level and 4,000-foot launch altitudes were used to determine the variation in performance and wind effect. The ICAO standard Atmosphere was used for the sea level computations, while a standard Atmosphere developed especially for the WSMR Area was used for the 4,000-foot altitude.

The trajectories were calculated from the following equations:

$$M\ddot{X} = T\cos\phi - \left(F_d + F_L\left(\frac{\dot{X} - U}{V_R}\right)\right) \tag{1}$$

$$M\ddot{Z} = T\sin\phi - (F_d - F_L)\frac{\dot{Z}}{V_R} \tag{2}$$

$$M V \dot{\theta} = -T\cos\delta - F_L\sin\left(\delta - \frac{U\cos\theta}{V + U\sin\theta}\right) + M_g\sin\theta \tag{3}$$

$$MK^2\ddot{\phi} = -F_m\sin\left(\delta - \frac{U\cos\theta}{1 + U\sin\theta}\right) - \dot{M}\dot{\phi}\,(r_e r_t - K^2) \tag{4}$$

where:

M = Mass.

T = Thrust.

F_d = Aerodynamic Drag.

F_L = Aerodynamic Lift.

$\ddot{X}$ = Horizontal Acceleration.

r_e = Distance from axis to center of exit.

r_t = Distance from axis to center of throat.

$\ddot{Z}$ = Vertical Acceleration,

g = Acceleration.

$\phi = \text{Tan}^{-1}(Z/X)$,

δ = Yaw Angle,

U = Wind.

$M K^2 \dot{\phi}$ = Rate of change of the moment of momentum,

$M V \theta$ = The total of exterior and jet forces acting on the rocket.

There are no provisions in two-dimensional equations of motion for determining rocket displacement due to Coriolis acceleration; however, this effect is small and a close approximation can be found from

$$C_w = 8/3 \text{ hp } W \cos \alpha \sqrt{\frac{2 \text{ hp}}{\bar{g}}} \qquad (5)$$

where

C_w = Coriolis-displacement west,

hp = peak altitude,

α = latitude angle of the launcher,

W = Earth's angular velocity, and

$\bar{g}$ = average value of acceleration due to gravity.

North-South Coriolis effect for the Arcas is quite small and may be neglected.

Calculation of Wind-Weighting Factors

For a given launcher exit velocity, the variation in the wind-weighting curves for different gross launch weights is negligible; however, there is a significant difference in these curves for different launcher exit velocities.

Wind-weighting factors for different launch velocities are presented in Tables I through III. Weighting factors for the Boosted Arcas are presented in Table IV. The performance of the Arcas is presented in Figures 1 through 6 for gross launch weights of 73, 75, 77, and 79 pounds, with exit velocities of (120, 150, and 175) ft/sec, and in Figures 7 through 18 for gross launch weights of 75, 77, and 79 pounds, with launched velocities from (200 to 310) ft/sec. Figure 19 is a graph of no wind impact range for WSMR as a function of launch elevation (degrees from vertical). Figures 20 through 27 are plots of Boosted Arcas performance.

CONCLUSION

The performance of the Arcas for the 4000-foot launch altitude is an approximate 20-percent improvement over the performance attained with a sea-level launch. This improved performance results in a unit wind effect which is about 12 percent greater with the 4000-foot altitude.

The unit wind effect decreases for increased launcher exit velocities. For increases in exit velocities from 120 to 150, 120 to 175, and 150 to 175 feet/second, the decreases in the unit wind effect are 6, 12, and 5 percent, respectively; for increases in exit velocities from 200 to 235, 200 to 275, and 235 to 310 feet/second, the wind effect decreases approximately 8, 18, and 22 percent, respectively. Therefore, to obtain a small unit wind effect, a higher launcher exit velocity would be used.

The performance of the Boosted Arcas for 4000-foot launch altitude is an approximate 22.5 percent improvement over the performance attained with a sea-level launch. The Boosted Arcas is characterised by its comparatively high acceleration in the first few feet from the launcher, thus assuring a relatively low wind effect and improved performance.

TABLE I

ARCAS BALLISTIC FACTORS
(4,000-Foot Launch Altitude)

LAYER (FT ABOVE SURFACE)	EXIT VELOCITIES (FT/SEC) 120	150	175	200	210	220	250	280	310
15-- 50	.1350	.1250	.1100	.1000	.0900	.0820	.0790	.0640	.0565
50-- 100	.0790	.0690	.0690	.0605	.0620	.0620	.0559	.0550	.0385
100-- 200	.0990	.1040	.1010	.1005	.0970	.0930	.0890	.0880	.0850
200-- 300	.0850	.0820	.0740	.0800	.0790	.0800	.0790	.0760	.0690
300-- 400	.0640	.0630	.0650	.0610	.0625	.0635	.0590	.0515	.0560
400-- 600	.0805	.0870	.0950	.0880	.0875	.0845	.0845	.0795	.0825
600-- 800	.0725	.0630	.0750	.0675	.0670	.0685	.0605	.0650	.0650
800-- 1,000	.0450	.0480	.0365	.0485	.0490	.0515	.0510	.0520	.0525
1,000-- 1,200	.0345	.0375	.0365	.0350	.0385	.0390	.0405	.0430	.0410
1,200-- 1,400	.0305	.0300	.0290	.0310	.0300	.0305	.0345	.0330	.0310
1,400-- 1,600	.0250	.0250	.0265	.0270	.0265	.0265	.0290	.0285	.0285
1,600-- 1,800	.0215	.0235	.0230	.0230	.0235	.0235	.0235	.0270	.0250
1,800-- 2,000	.0165	.0175	.0185	.0195	.0205	.0210	.0190	.0210	.0220
2,000-- 3,000	.0520	.0525	.0550	.0595	.0620	.0640	.0745	.0690	.0765
3,000-- 4,000	.0330	.0330	.0350	.0375	.0370	.0380	.0330	.0435	.0470
4,000-- 5,000	.0250	.0250	.0255	.0295	.0300	.0275	.0340	.0365	.0380
5,000--10,000	.0370	.0450	.0500	.0540	.0575	.0610	.0630	.0660	.0745
10,000--15,000	.0200	.0220	.0240	.0245	.0250	.0260	.0280	.0305	.0335
15,000--20,000	.0140	.0150	.0165	.0145	.0155	.0170	.0180	.0205	.0225
20,000--25,000	.0100	.0090	.0095	.0105	.0115	.0120	.0135	.0130	.0140
25,000--30,000	.0060	.0070	.0075	.0085	.0085	.0085	.0085	.0095	.0115
30,000--35,000	.0045	.0060	.0060	.0050	.0050	.0050	.0065	.0080	.0075
35,000--40,000	.0035	.0035	.0045	.0060	.0060	.0050	.0050	.0060	.0050
40,000--45,000	.0040	.0035	.0035	.0035	.0035	.0040	.0045	.0040	.0055
45,000--50,000	.0015	.0025	.0020	.0035	.0035	.0035	.0035	.0040	.0040
50,000-BURNOUT	.0015	.0015	.0020	.0020	.0020	.0025	.0040	.0060	.0080

TABLE II

STANDARD ARCAS BALLISTIC FACTORS

(Payload = 77 pounds)　　　SEA-LEVEL LAUNCH　　　(QE = 85°)

	EXIT VELOCITIES (FT/SEC)								
LAYER (FEET)*	120	150	175	200	210	220	250	280	310
15--- 50	.1280	.1140	.1080	.0780	.0680	.0580	.0430	.0400	.0365
50--- 100	.0880	.0860	.0830	.0660	.0640	.0620	.0670	.0600	.0525
100--- 200	.1300	.1200	.1010	.1110	.1060	.1050	.1040	.1025	.0930
200--- 300	.0880	.0810	.0740	.0980	.0960	.0950	.0760	.0655	.0670
300--- 400	.0590	.0620	.0600	.0650	.0630	.0610	.0630	.0565	.0510
400--- 600	.0770	.0850	.0920	.0820	.0880	.0860	.0870	.0900	.0855
600--- 800	.0620	.0620	.0640	.0580	.0630	.0730	.0600	.0675	.0645
800--- 1,000	.0460	.0460	.0470	.0500	.0500	.0460	.0550	.0465	.0530
1,000--- 1,200	.0370	.0380	.0390	.0360	.0370	.0380	.0490	.0405	.0410
1,200--- 1,400	.0270	.0320	.0330	.0340	.0310	.0340	.0330	.0355	.0315
1,400--- 1,600	.0220	.0220	.0270	.0290	.0300	.0280	.0270	.0305	.0275
1,600--- 1,800	.0180	.0180	.0200	.0230	.0220	.0200	.0220	.0235	.0250
1,800--- 2,000	.0160	.0160	.0160	.0200	.0180	.0190	.0190	.0195	.0230
2,000--- 3,000	.0540	.0540	.0540	.0570	.0630	.0630	.0680	.0750	.0780
3,000--- 4,000	.0280	.0310	.0340	.0350	.0370	.0390	.0390	.0425	.0450
4,000--- 5,000	.0200	.0230	.0270	.0260	.0270	.0320	.0330	.0350	.0370
5,000---10,000	.0430	.0480	.0510	.0560	.0570	.0540	.0640	.0720	.0780
10,000---15,000	.0190	.0200	.0220	.0240	.0250	.0250	.0290	.0290	.0350
15,000---20,000	.0110	.0110	.0130	.0150	.0160	.0160	.0180	.0190	.0220
20,000---25,000	.0080	.0090	.0090	.0100	.0105	.0110	.0120	.0135	.0140
25,000---30,000	.0055	.0070	.0060	.0070	.0075	.0080	.0080	.0100	.0110
30,000---35,000	.0050	.0050	.0050	.0060	.0060	.0060	.0070	.0080	.0085
35,000---40,000	.0035	.0040	.0050	.0050	.0055	.0060	.0050	.0050	.0055
40,000---45,000	.0025	.0030	.0030	.0040	.0049	.0040	.0050	.0060	.0055
45,000---50,000	.0015	.0020	.0040	.0030	.0030	.0040	.0050	.0055	.0045
50,000--BURNOUT	.0010	.0010	.0010	.0020	.0020	.0020	.0020	.0015	.0040

*HEIGHTS ARE ABOVE SEA-LEVEL SURFACE

TABLE III

ARCAS BALLISTIC FACTORS FOR THE FIRST 200-FEET OF THE ATMOSPHERE

SEA LEVEL

LAYER* FEET	EXIT VELOCITIES--FEET/SECOND 120	150	175	200	210
15 - 37.5	.079	.074	.064	.048	.037
37.5- 62.5	.075	.064	.063	.046	.044
62.5- 87.5	.038	.044	.045	.034	.033
87.5-112.5	.038	.042	.039	.034	.032
112.5-200	.116	.096	.081	.093	.092

LAYER* FEET	EXIT VELOCITIES--FEET/SECOND 220	250	280	310
15- 37.5	.032	.030	.028	.024
37.5- 62.5	.039	.036	.034	.028
62.5- 87.5	.039	.033	.030	.026
87.5-112.5	.026	.029	.027	.025
112.5-200	.088	.086	.084	.080

4,000 FEET

LAYER** FEET	EXIT VELOCITIES--FEET/SECOND 120	150	175	200	210
15 - 37.5	.092	.086	.080	.070	.065
37.5- 62.5	.068	.060	.052	.047	.043
62.5- 87.5	.038	.037	.036	.031	.030
87.5-112.5	.030	.029	.028	.030	.029
112.5-200	.085	.086	.084	.083	.082

LAYER** FEET	EXIT VELOCITIES--FEET/SECOND 220	250	280	310
15 - 37.5	.060	.050	.040	.035
37.5- 62.5	.040	.038	.036	.027
62.5- 87.5	.029	.028	.027	.024
87.5-112.5	.029	.028	.027	.020
112.5-200	.079	.079	.077	.074

*HEIGHTS ARE ABOVE SEA-LEVEL SURFACE

**HEIGHTS ARE ABOVE 4000-FOOT LEVEL

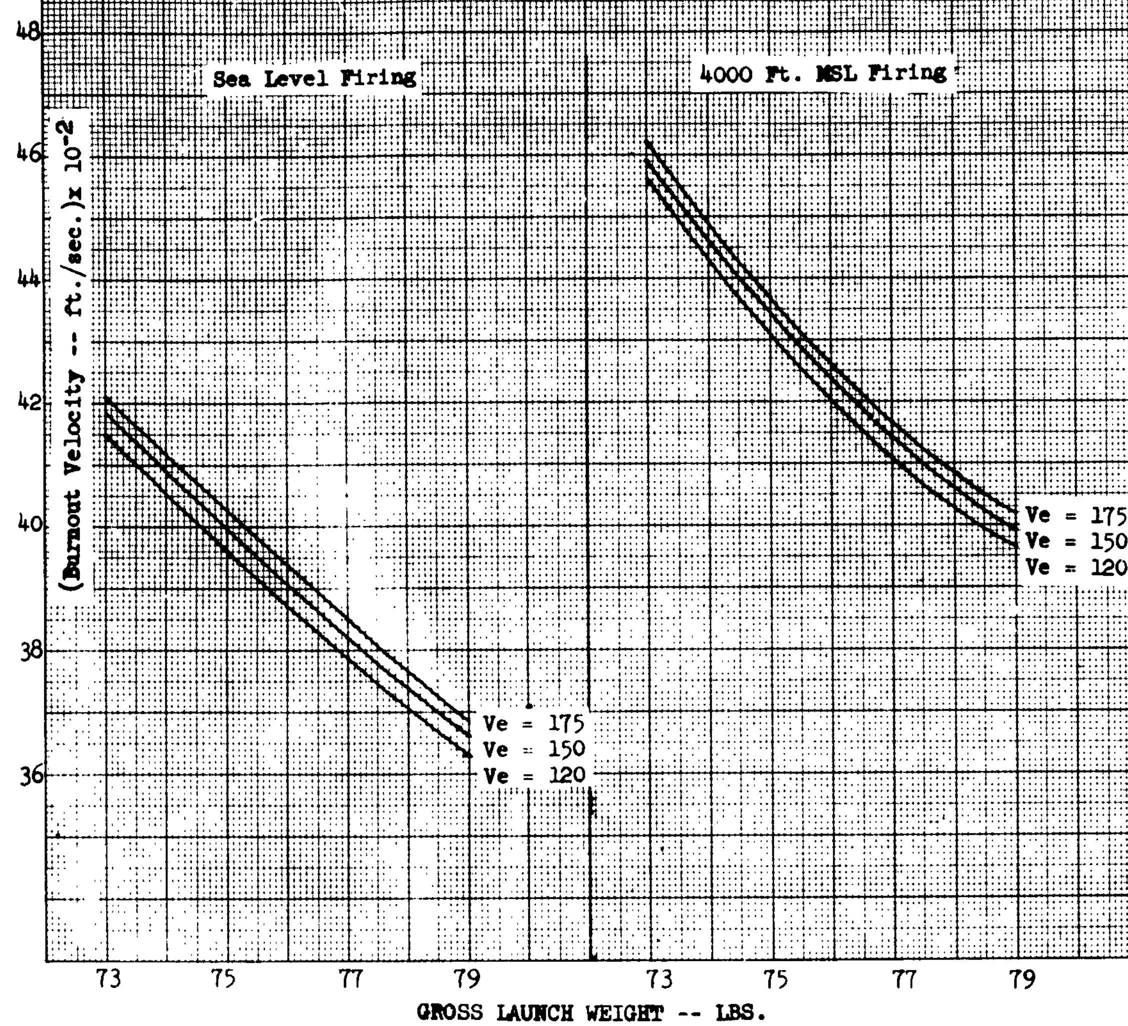
TABLE IV

BOOSTED ARCAS BALLISTIC FACTORS

LAYERS (FEET)	SEA-LEVEL 8-LB PAYLOAD	4000-FT LEVEL 10-LB PAYLOAD
15-- 50	.2420	.2640
50-- 100	.1580	.1130
100-- 200	.1350	.1150
200-- 300	.0620	.0810
300-- 400	.0340	.0400
400-- 600	.0320	.0310
600-- 800	.0145	.0140
800-- 1,000	.0105	.0120
1,000-- 1,200	.0100	.0110
1,200-- 1,400	.0090	.0100
1,400-- 1,600	.0080	.0090
1,600-- 1,800	.0090	.0080
1,800-- 2,000	.0070	.0080
2,000-- 3,000	.0350	.0415
3,000-- 4,000	.0250	.0285
4,000-- 5,000	.0220	.0080
5,000--10,000	.0610	.0730
10,000--15,000	.0320	.0350
15,000--20,000	.0205	.0220
20,000--25,000	.0150	.0150
25,000--30,000	.0140	.0120
30,000--35,000	.0105	.0100
35,000--40,000	.0090	.0090
40,000--45,000	.0065	.0080
45,000--50,000	.0060	.0070
50,000--55,000	.0055	.0060
55,000--60,000	.0050	.0050
60,000-BURNOUT	.0020	.0040

FIGURE 1

BURNOUT VELOCITY AS A FUNCTION OF GROSS LAUNCH WEIGHT, LAUNCH ALTITUDE, AND LAUNCHER EXIT VELOCITY



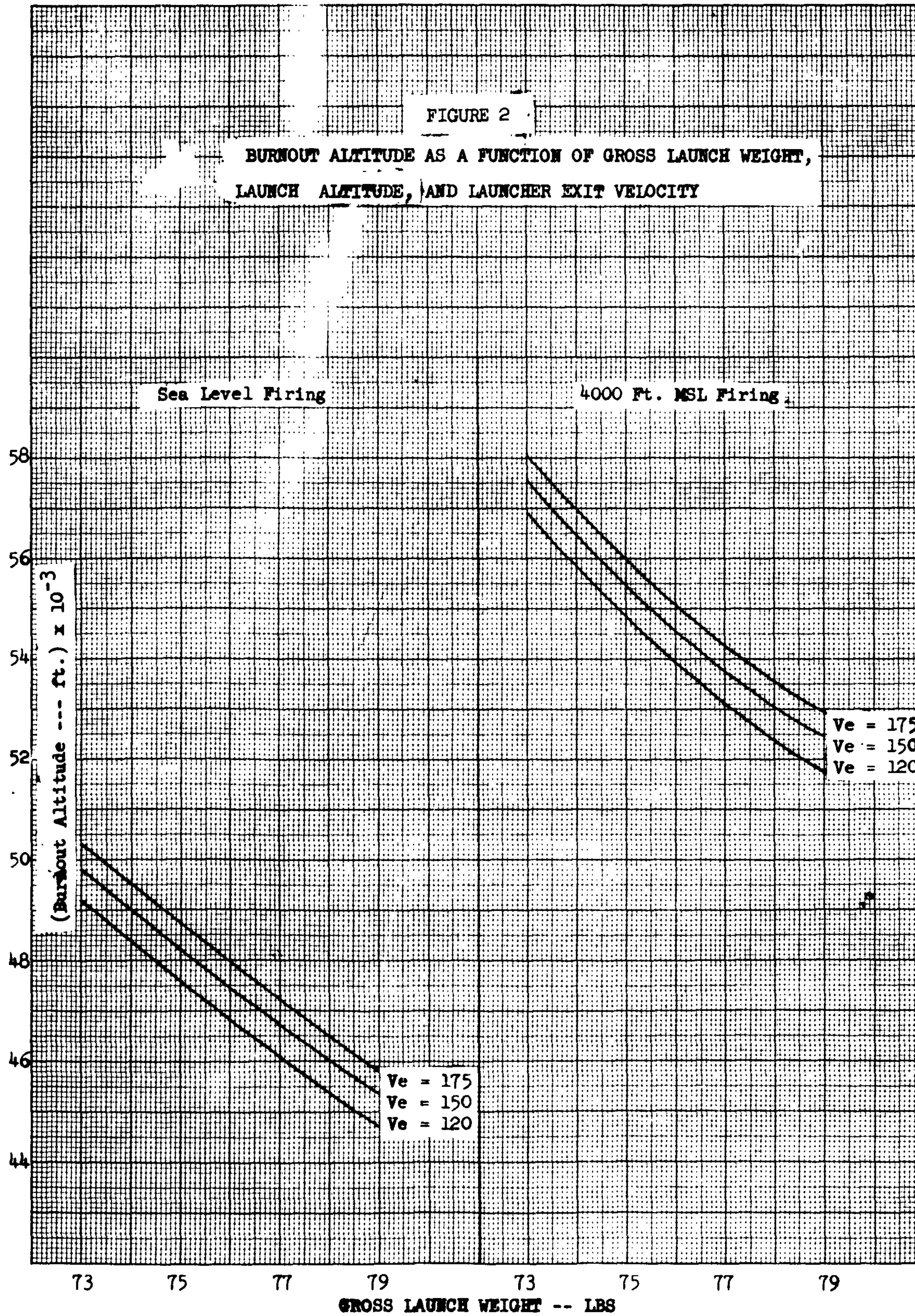


FIGURE 2
BURNOUT ALTITUDE AS A FUNCTION OF GROSS LAUNCH WEIGHT,
LAUNCH ALTITUDE, AND LAUNCHER EXIT VELOCITY
Sea Level Firing
4000 Ft. MSL Firing
(Burnout Altitude --- ft.) x 10-3
58
56
54
52
50
48
46
44
Ve = 175
Ve = 150
Ve = 120
Ve = 175
Ve = 150
Ve = 120
73
75
77
79
73
75
77
79
GROSS LAUNCH WEIGHT -- LBS

FIGURE 3

PEAK ALTITUDE AS A FUNCTION OF GROSS LAUNCH WEIGHT, LAUNCH ALTITUDE, AND LAUNCHER EXIT VELOCITY

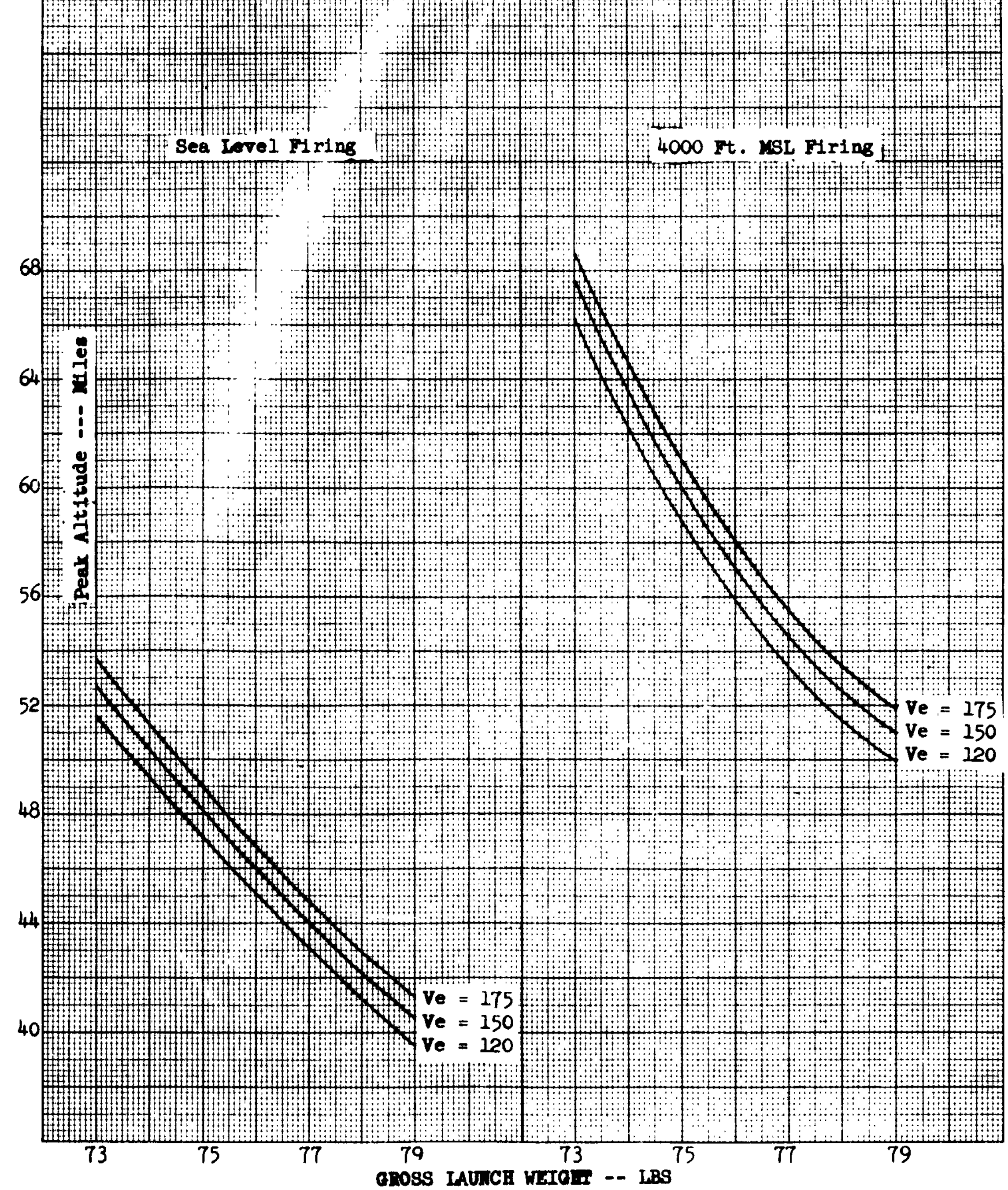


FIGURE 4

TIME TO PEAK AS A FUNCTION OF GROSS LAUNCH WEIGHT, LAUNCH ALTITUDE, AND LAUNCHER EXIT VELOCITY

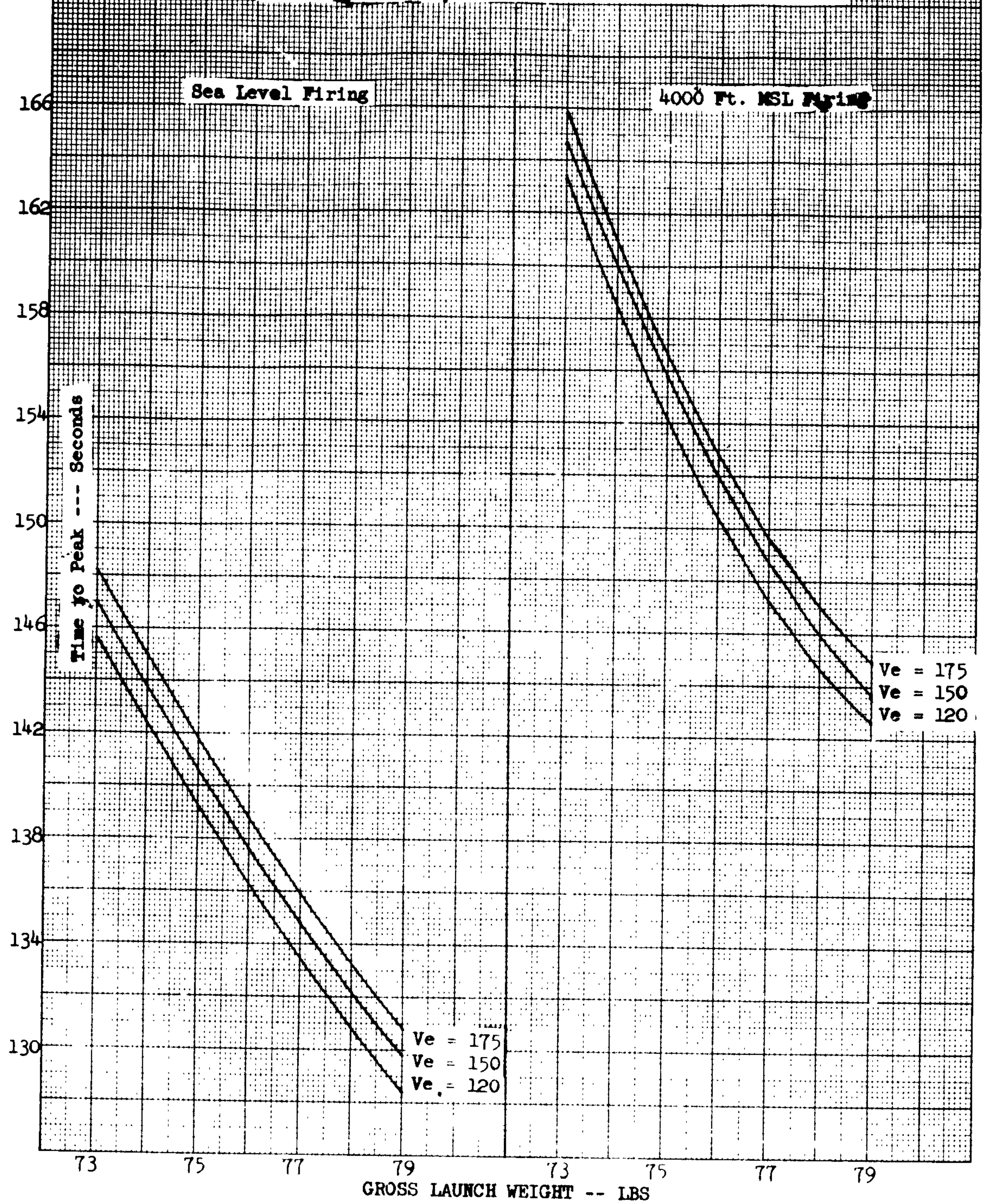
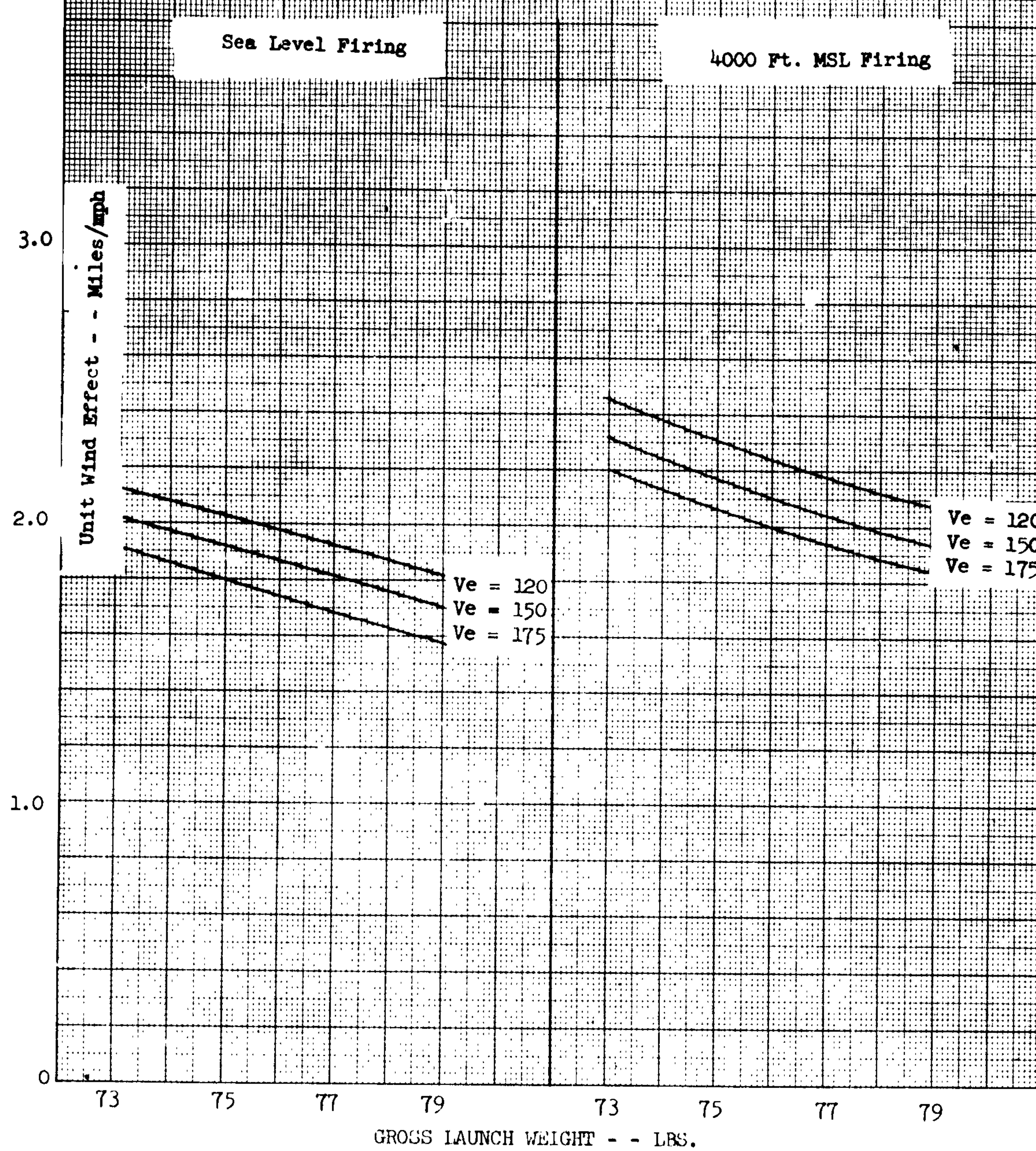


FIGURE 5

UNIT WIND EFFECT AS A FUNCTION OF GROSS LAUNCH WEIGHT, LAUNCH ALTITUDE, AND LAUNCHER EXIT VELOCITY



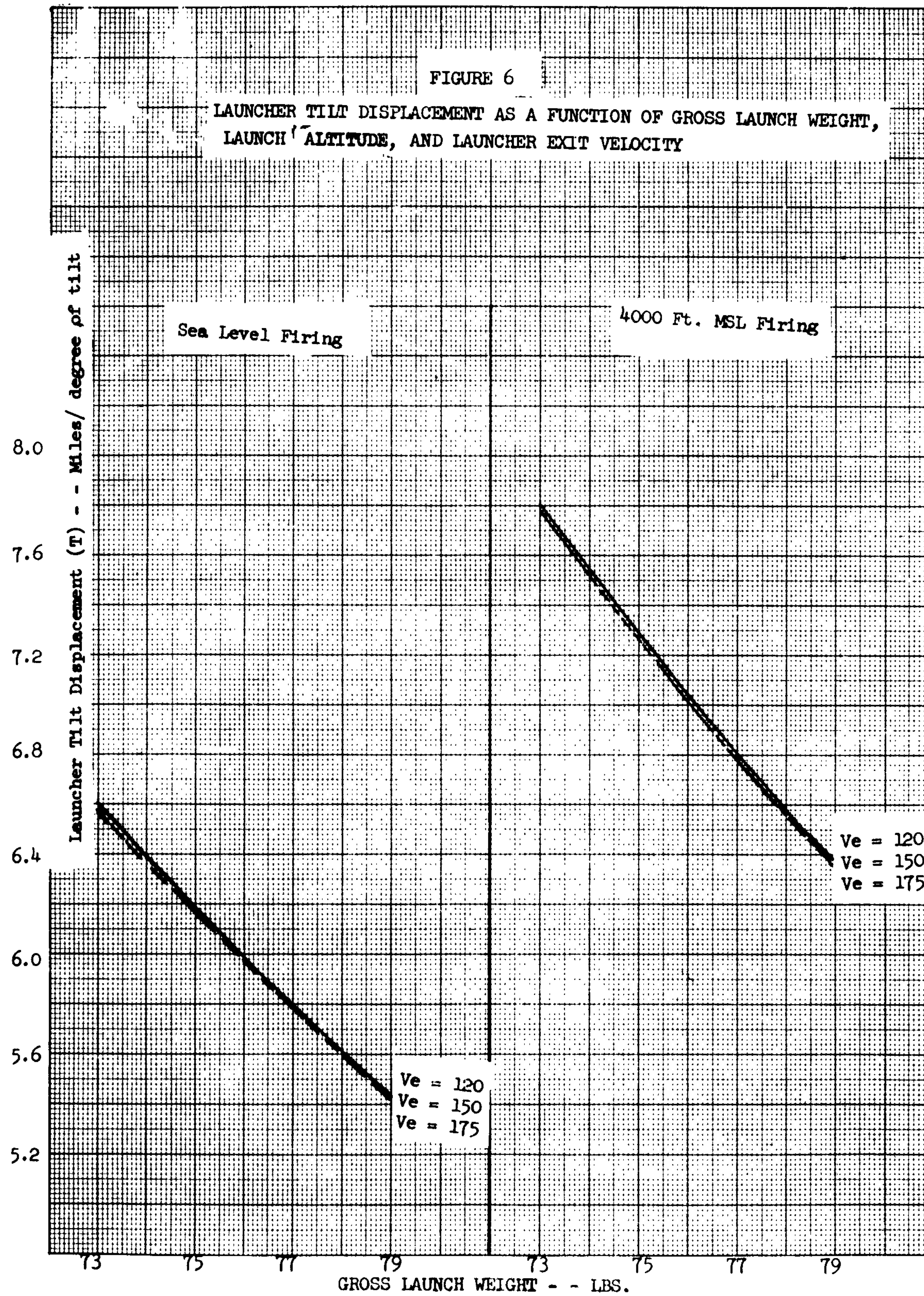


FIGURE 6
LAUNCHER TILT DISPLACEMENT AS A FUNCTION OF GROSS LAUNCH WEIGHT, LAUNCH ALTITUDE, AND LAUNCHER EXIT VELOCITY
Sea Level Firing
4000 Ft. MSL Firing
Launcher Tilt Displacement (T) - - Miles/ degree of tilt
8.0
7.6
7.2
6.8
6.4
6.0
5.6
5.2
Ve = 120
Ve = 150
Ve = 175
Ve = 120
Ve = 150
Ve = 175
73
75
77
79
73
75
77
79
GROSS LAUNCH WEIGHT - - LBS.

FIGURE 7 BURNOUT VELOCITY vs LAUNCH WEIGHT AND LAUNCH VELOCITY
Launch altitude - 4000 feet MSL

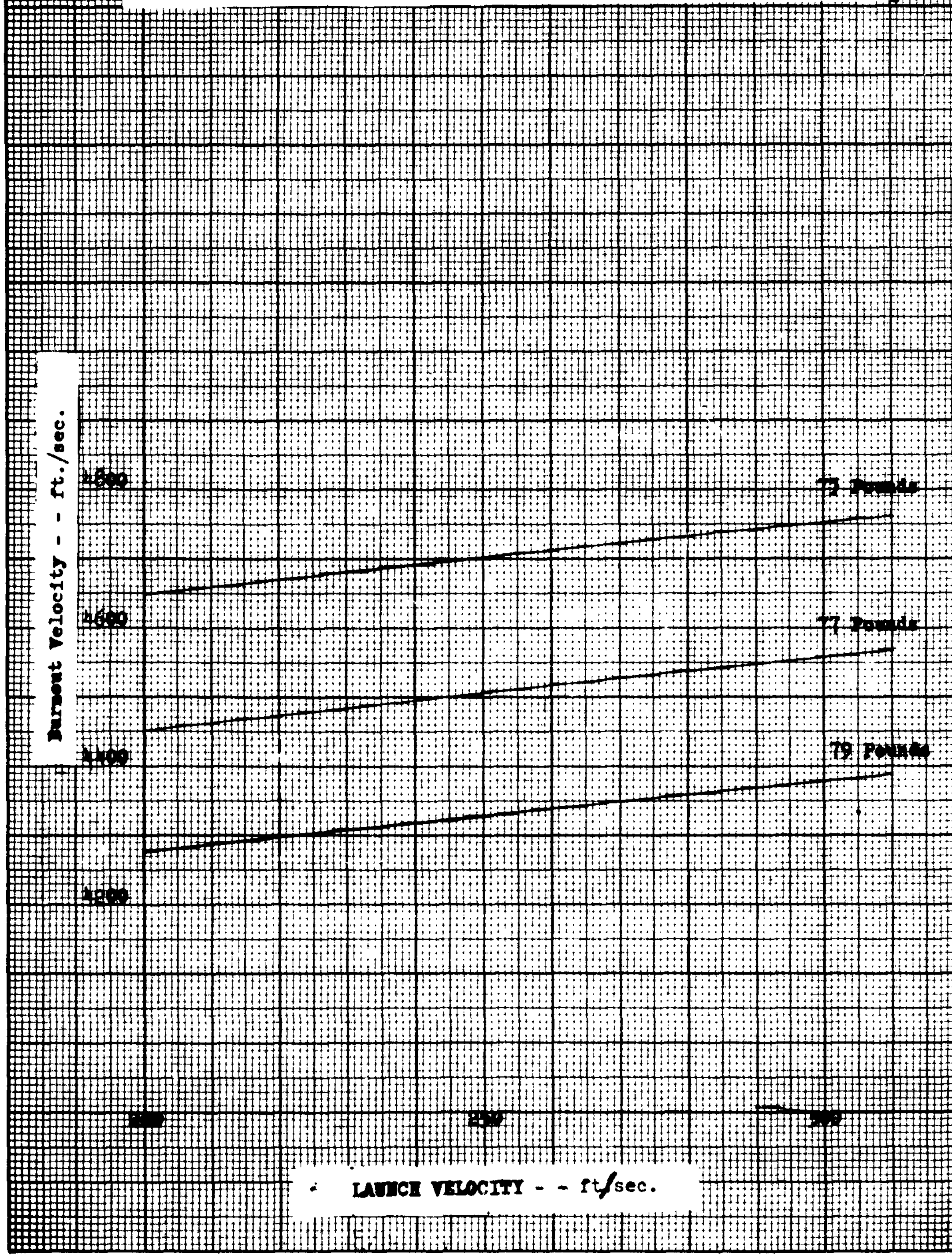
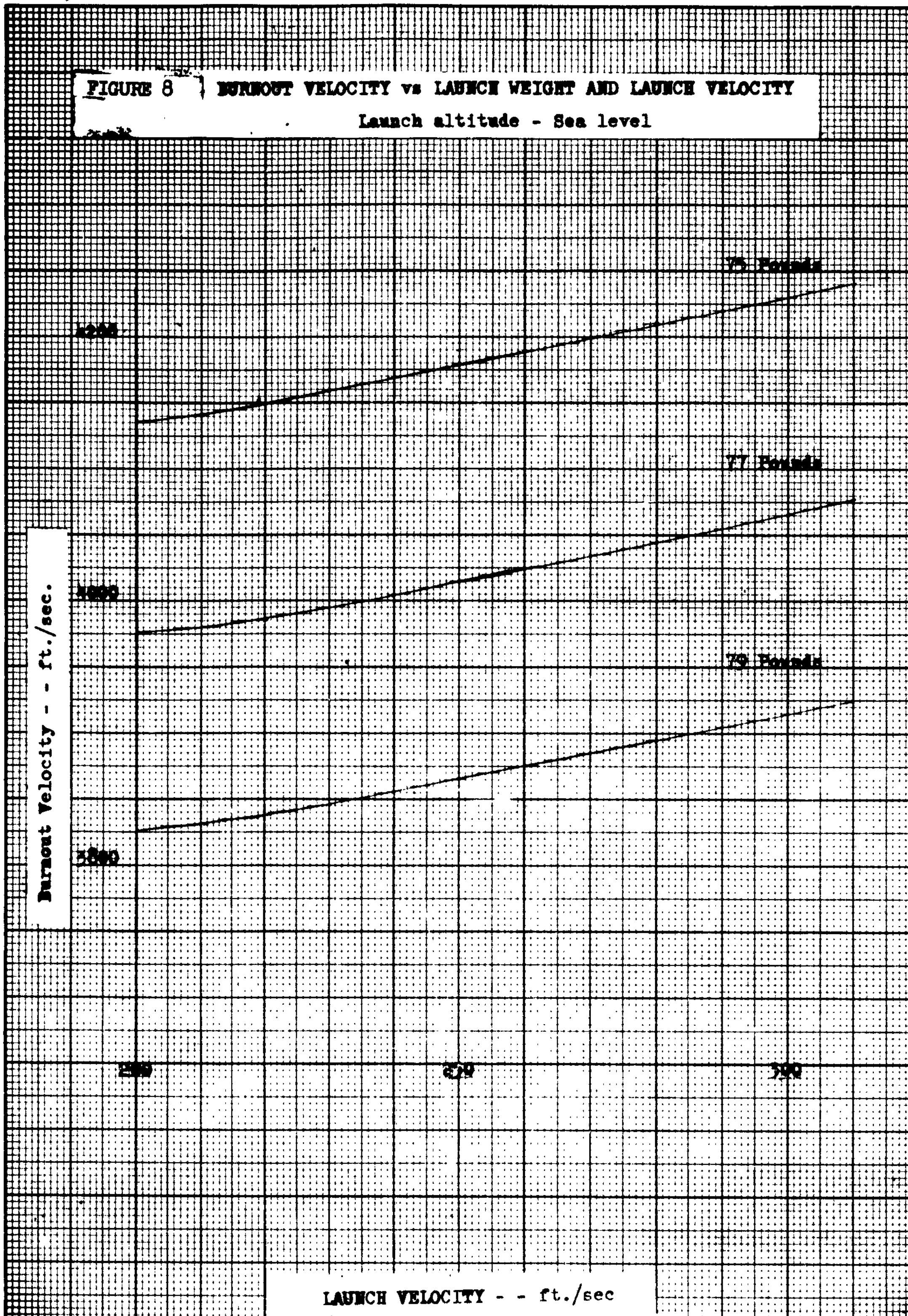


FIGURE 8 BURNOUT VELOCITY vs LAUNCH WEIGHT AND LAUNCH VELOCITY

Launch altitude - Sea level



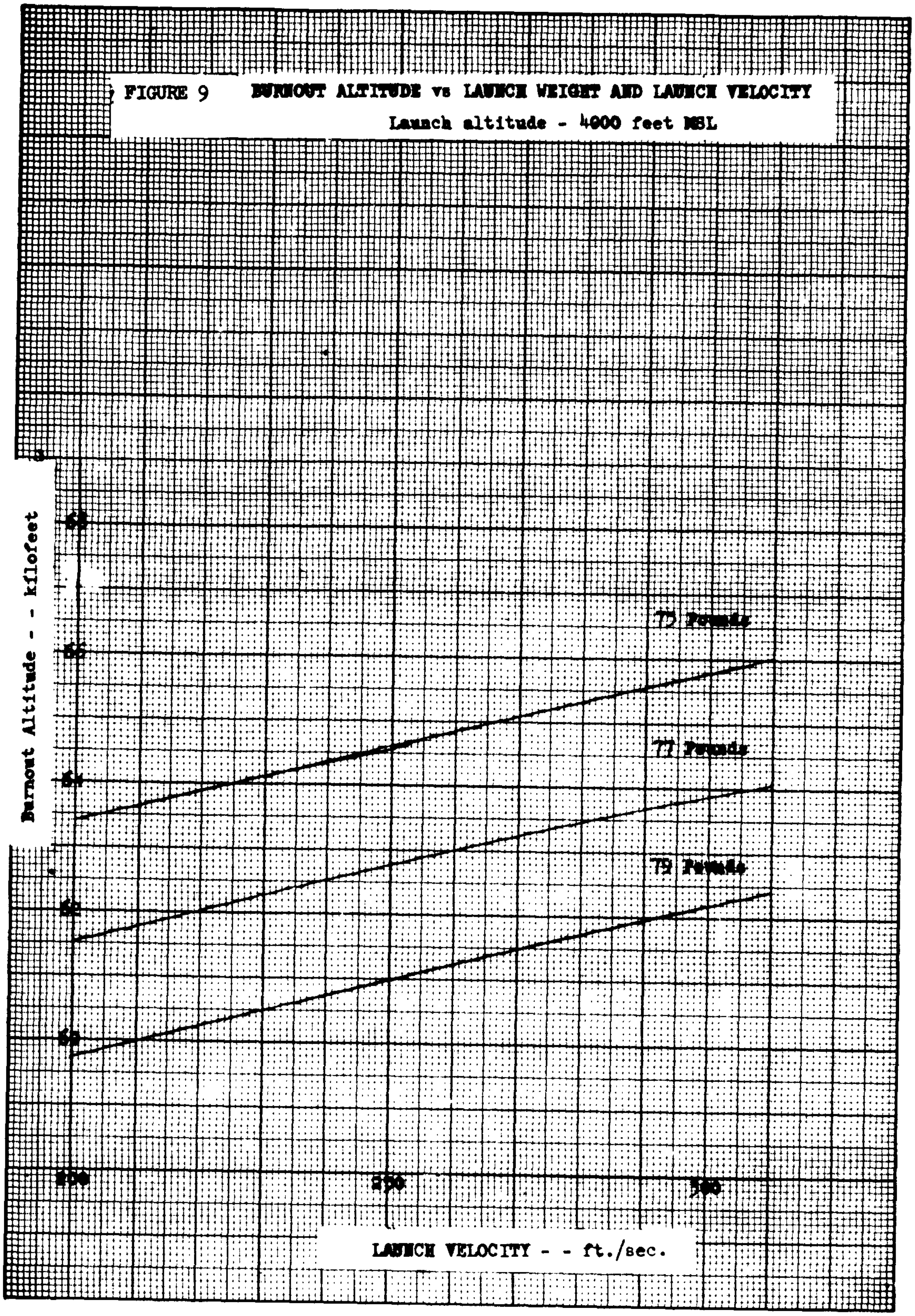


FIGURE 9 BURNOUT ALTITUDE vs LAUNCH WEIGHT AND LAUNCH VELOCITY

Launch altitude - 4900 feet MSL

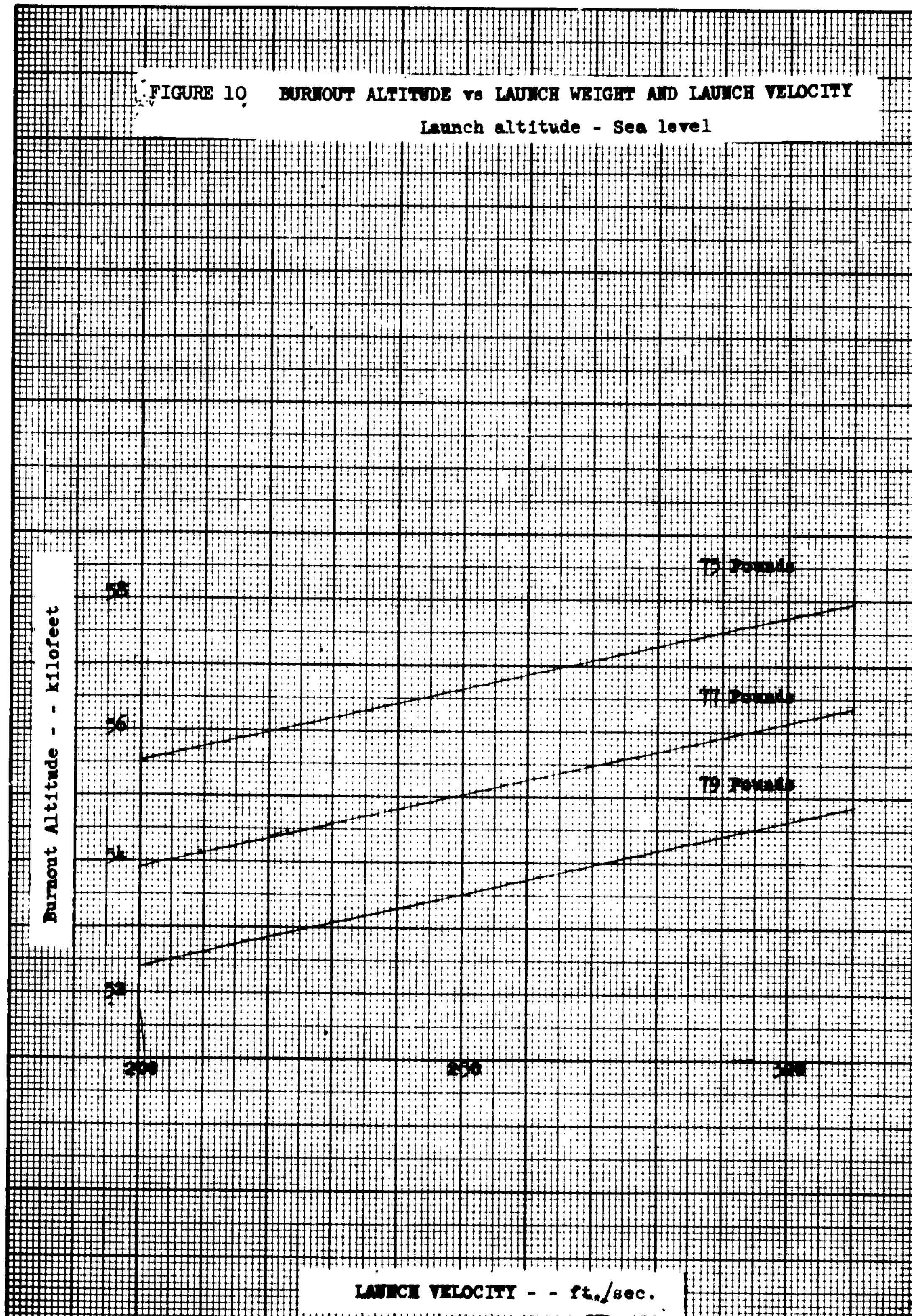


FIGURE 10 BURNOUT ALTITUDE vs LAUNCH WEIGHT AND LAUNCH VELOCITY

Launch altitude - Sea level

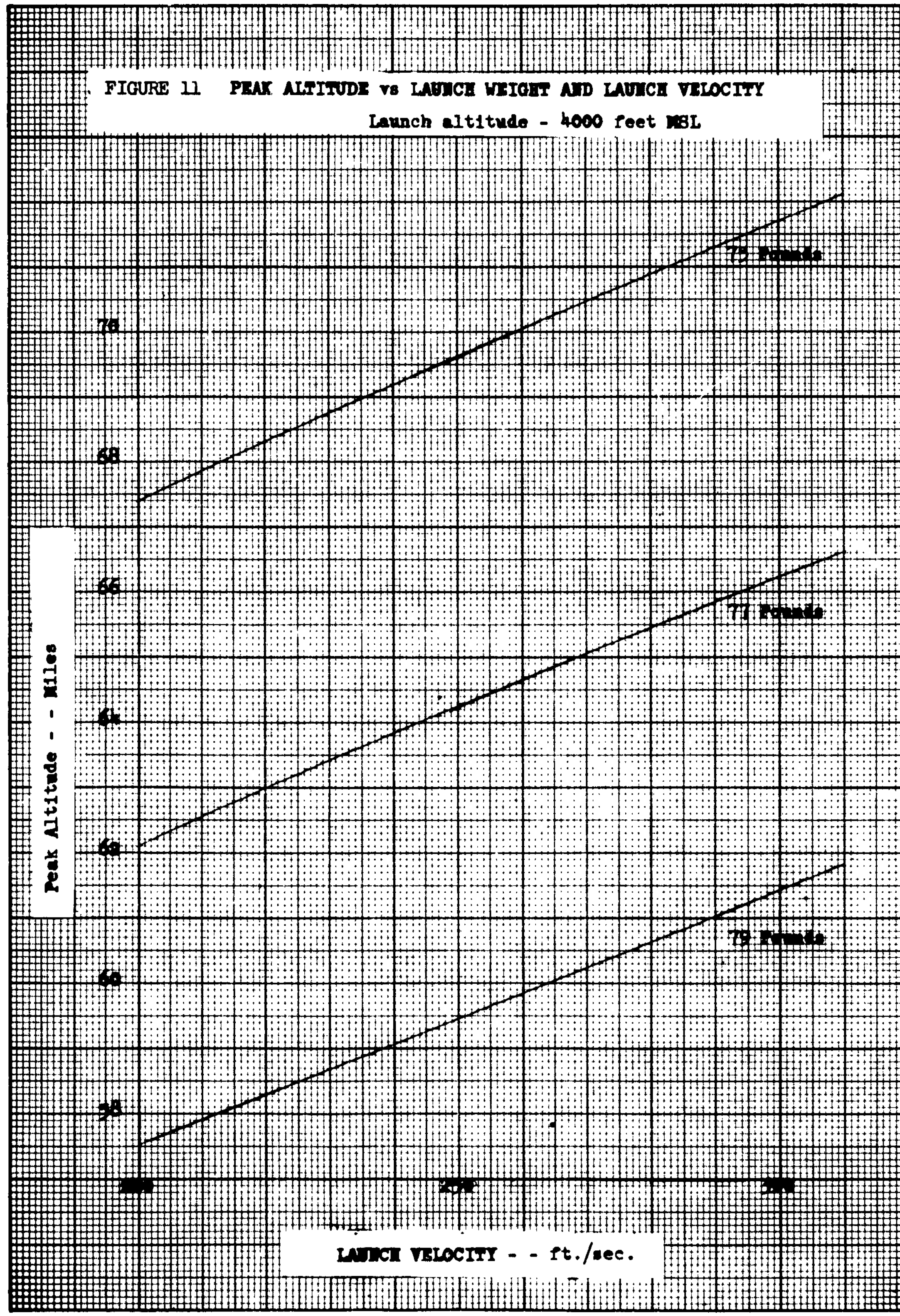


FIGURE 11 PEAK ALTITUDE vs LAUNCH WEIGHT AND LAUNCH VELOCITY

Launch altitude - 4000 feet MSL

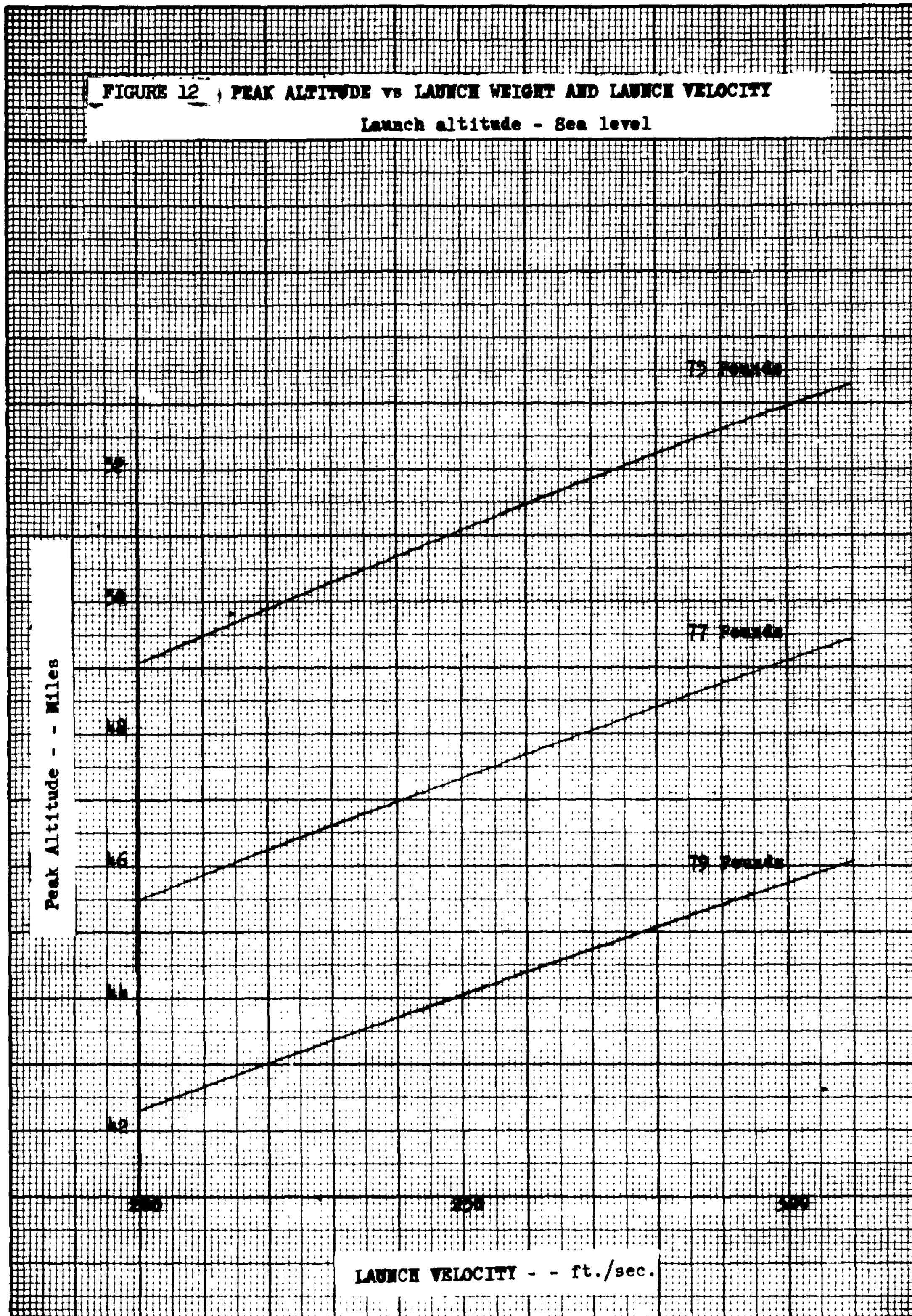
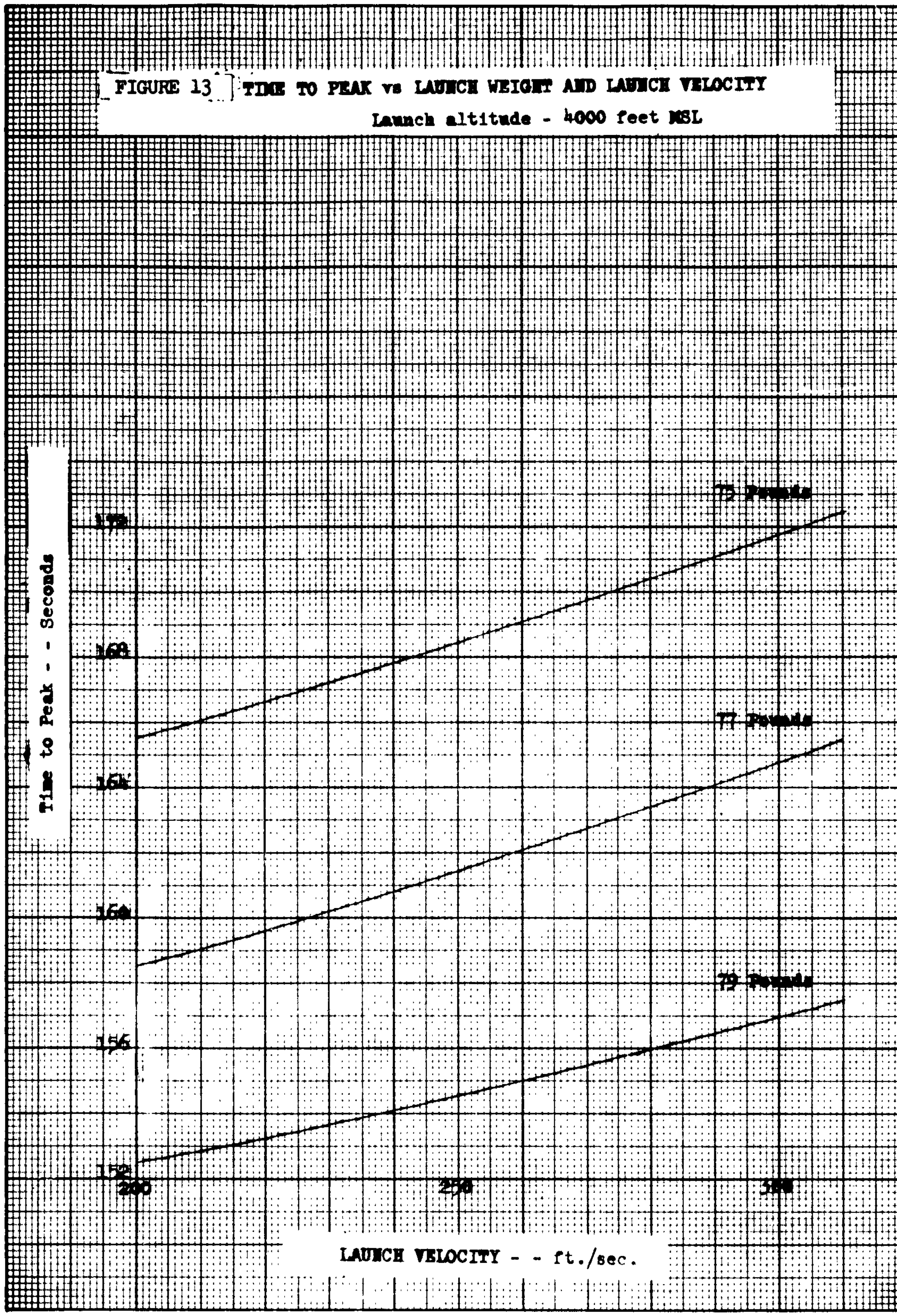


FIGURE 12 PEAK ALTITUDE vs LAUNCH WEIGHT AND LAUNCH VELOCITY
Launch altitude - Sea level

FIGURE 13 TIME TO PEAK vs LAUNCH WEIGHT AND LAUNCH VELOCITY

Launch altitude - 4000 feet MSL



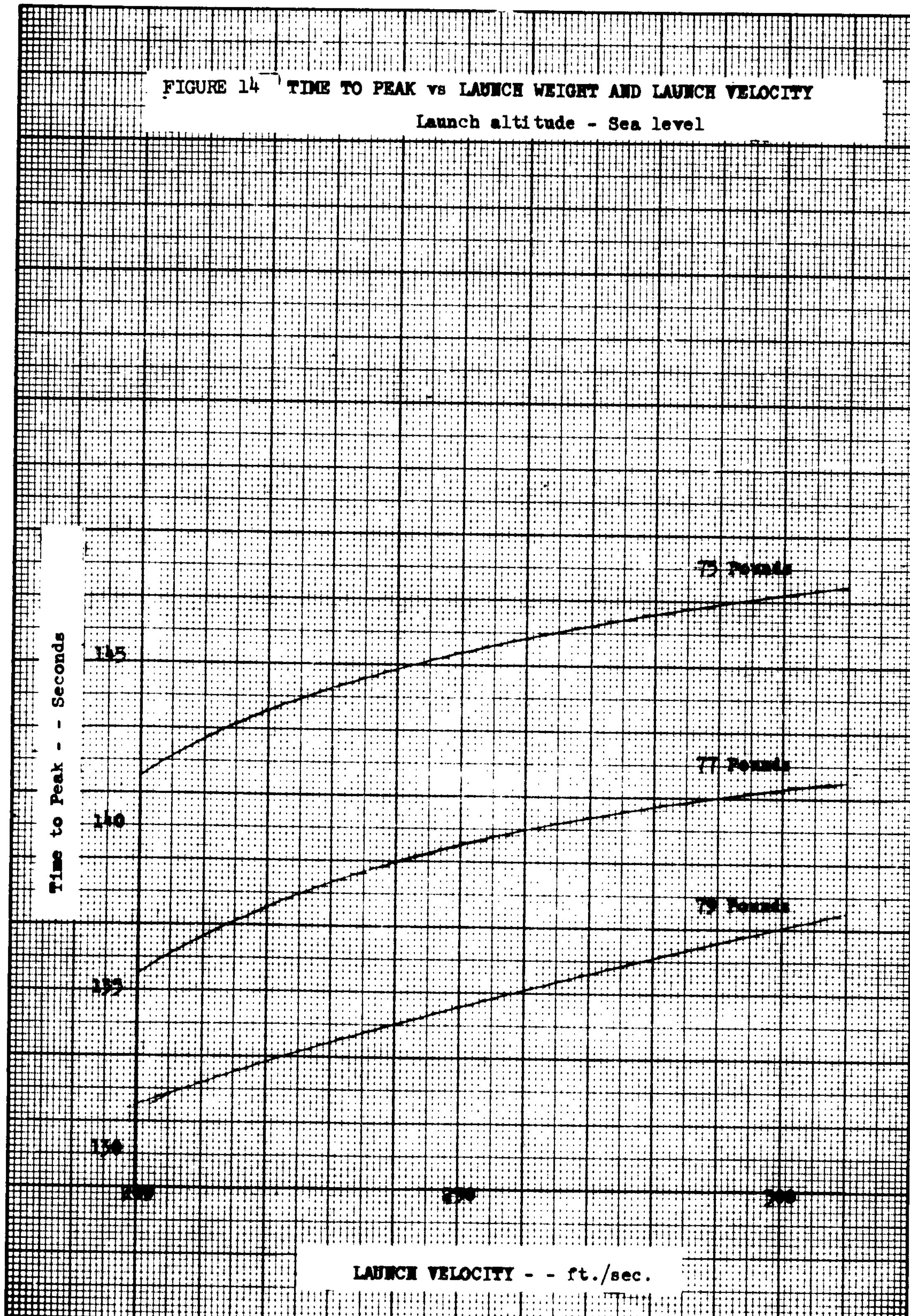


FIGURE 14 TIME TO PEAK vs LAUNCH WEIGHT AND LAUNCH VELOCITY

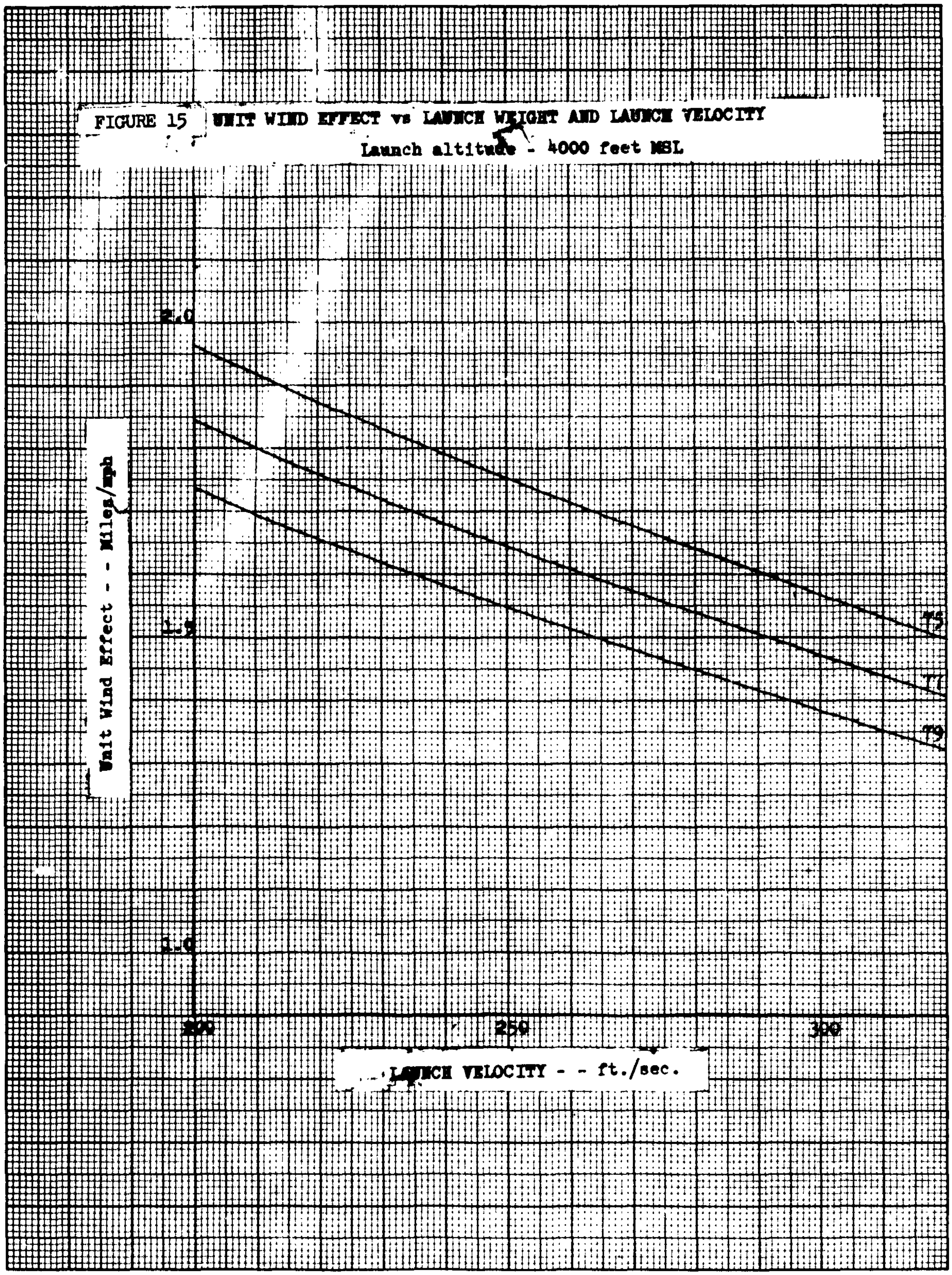
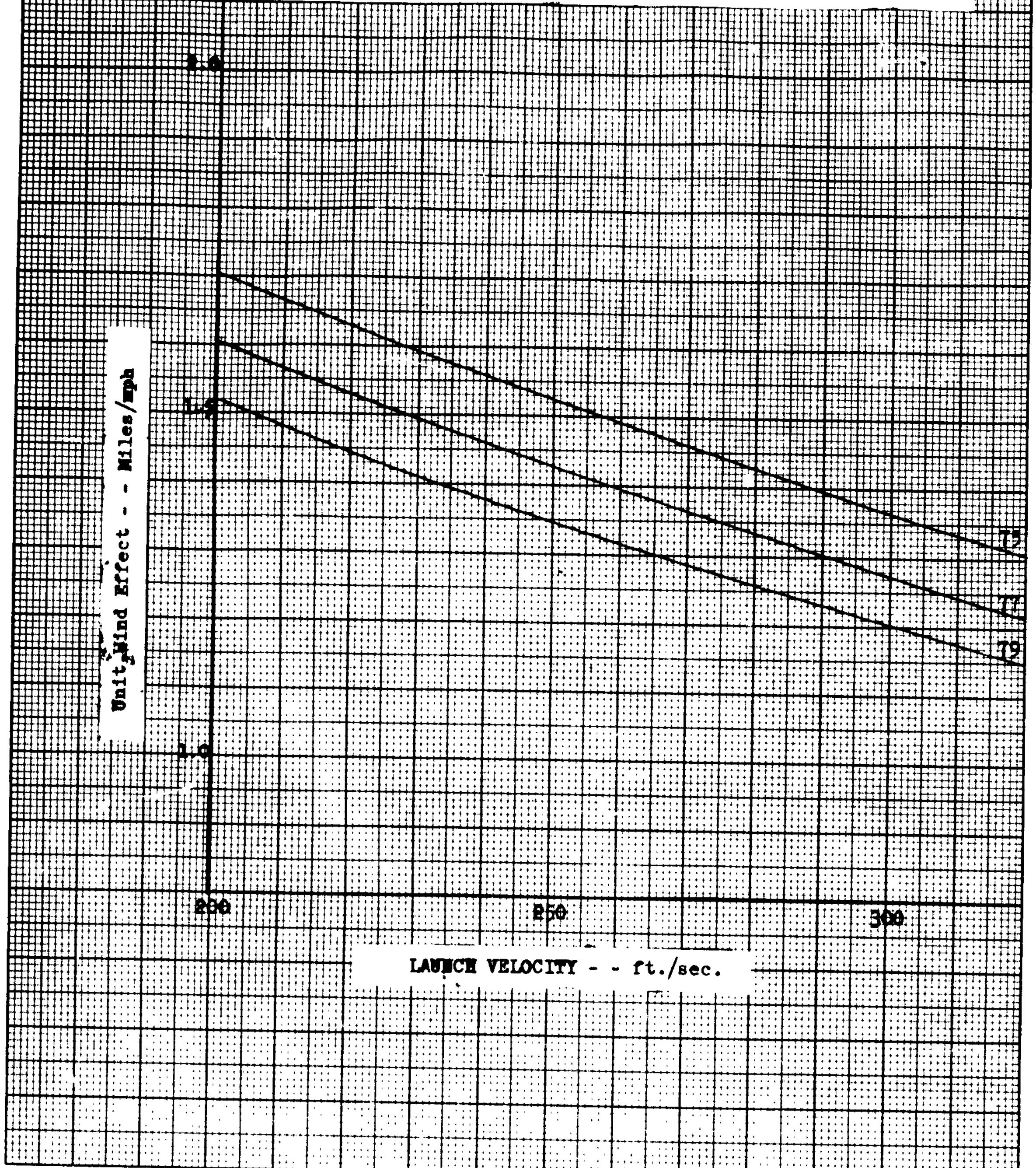


FIGURE 15 UNIT WIND EFFECT vs LAUNCH WEIGHT AND LAUNCH VELOCITY
Launch altitude - 4000 feet MSL

FIGURE 16 UNIT WIND EFFECT vs LAUNCH WEIGHT AND LAUNCH VELOCITY

Launch altitude - Sea level



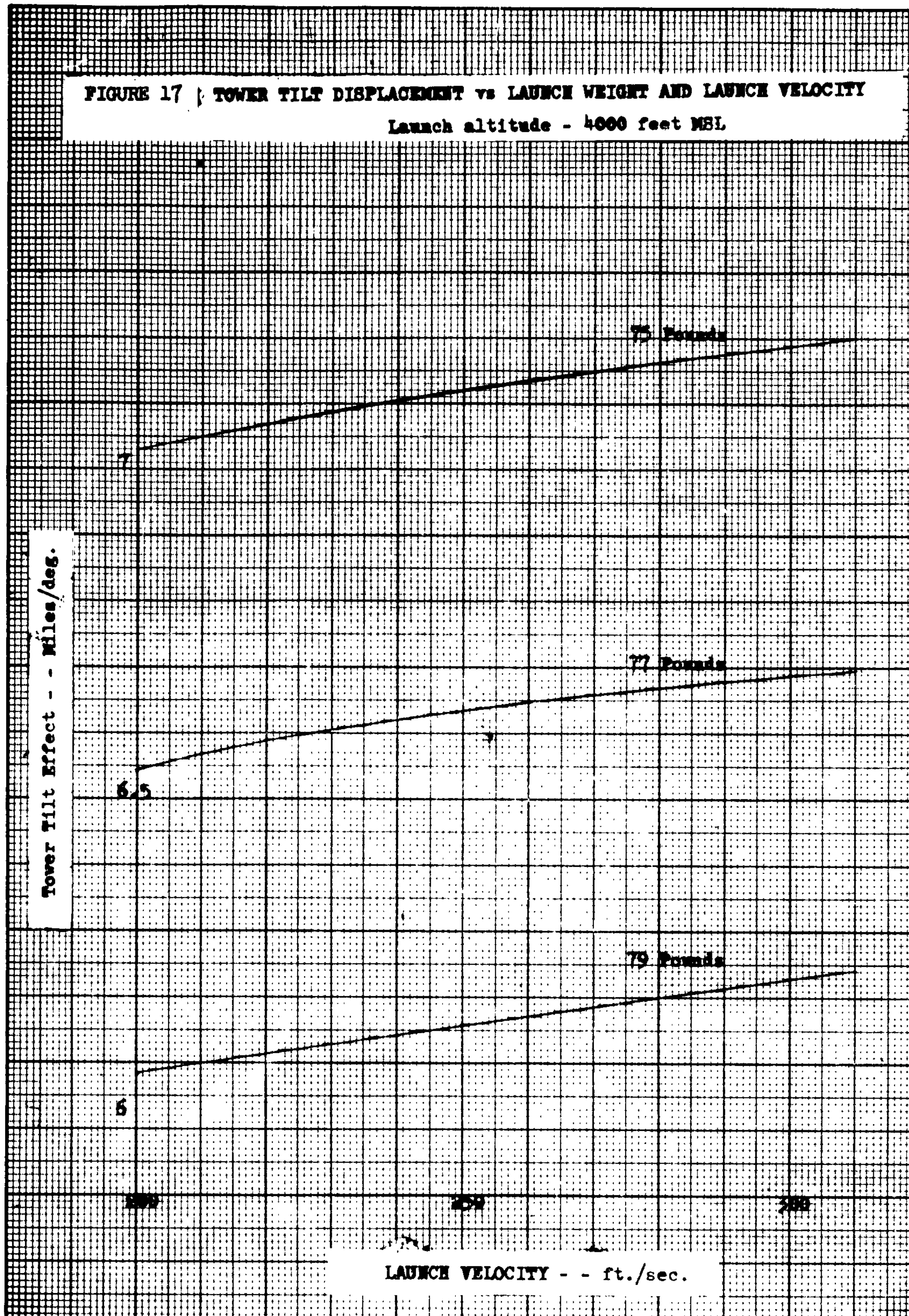
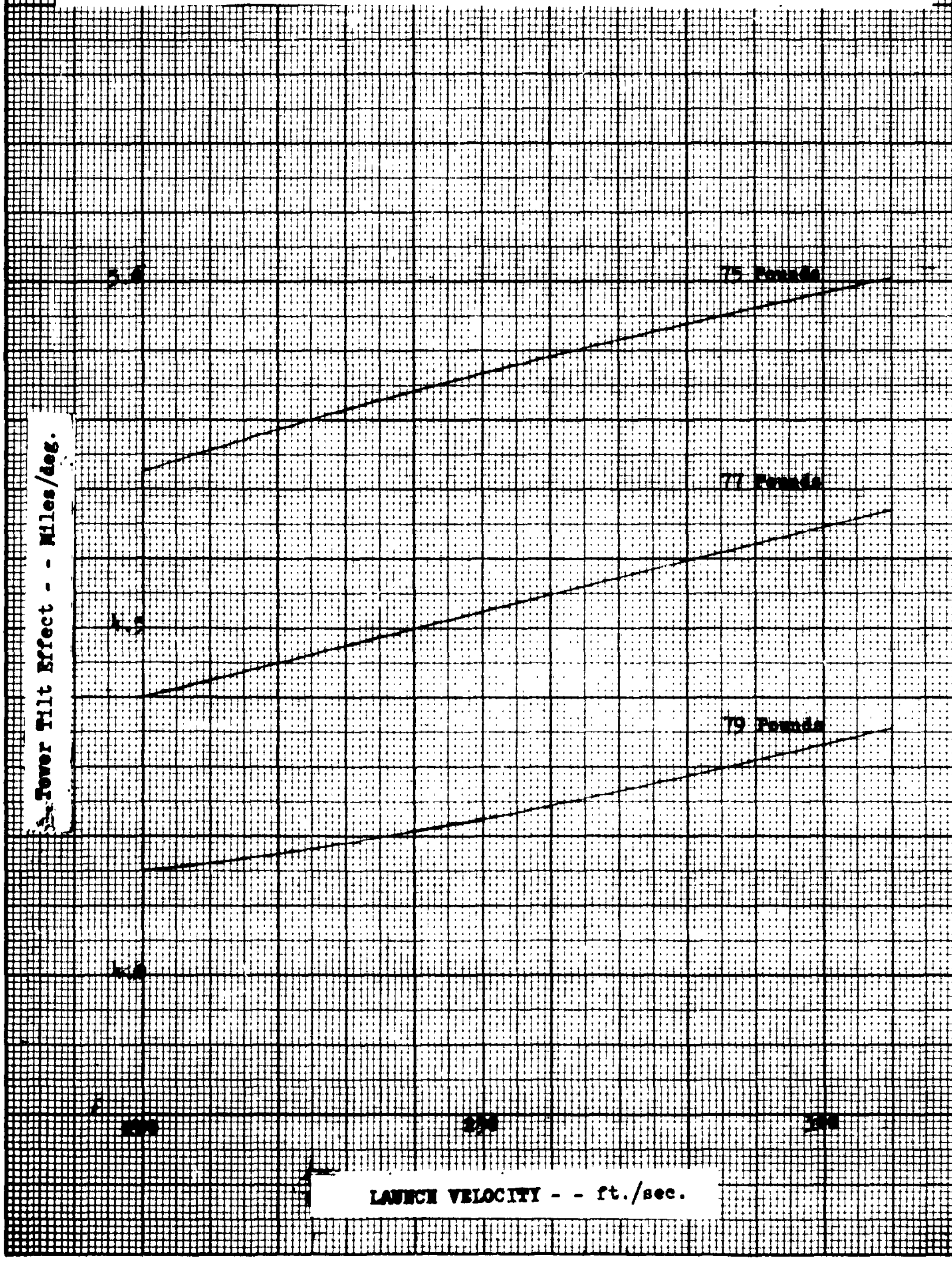


FIGURE 17 : TOWER TILT DISPLACEMENT vs LAUNCH WEIGHT AND LAUNCH VELOCITY
Launch altitude - 4000 feet MSL

FIGURE 18 TOWER TILT DISPLACEMENT vs LAUNCH WEIGHT AND LAUNCH VELOCITY

Launch altitude - Sea Level



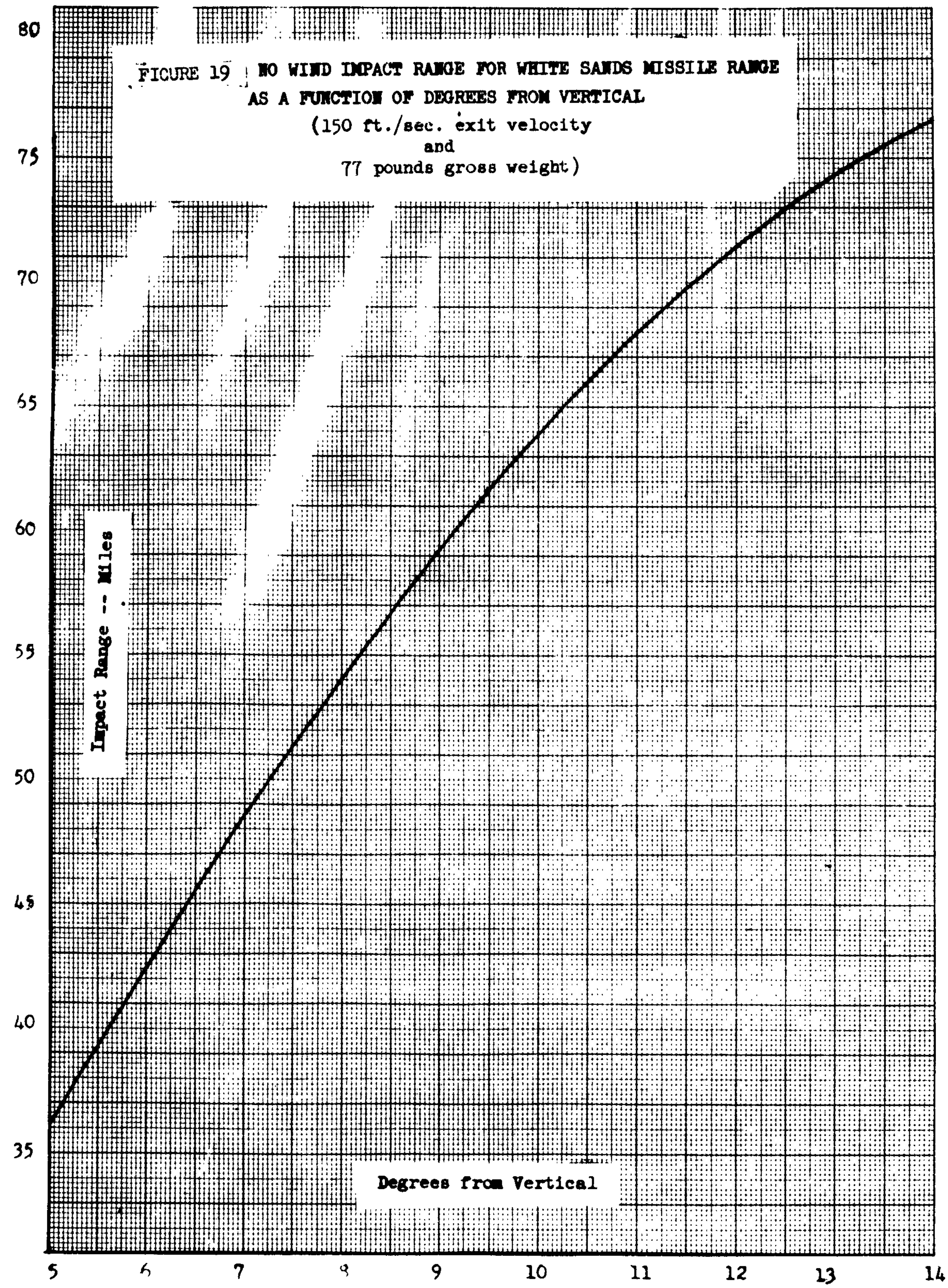


FIGURE 19 NO WIND IMPACT RANGE FOR WHITE SANDS MISSILE RANGE
AS A FUNCTION OF DEGREES FROM VERTICAL
(150 ft./sec. exit velocity
and
77 pounds gross weight)
Impact Range -- Miles
Degrees from Vertical
80
75
70
65
60
55
50
45
40
35
5
6
7
8
9
10
11
12
13
14

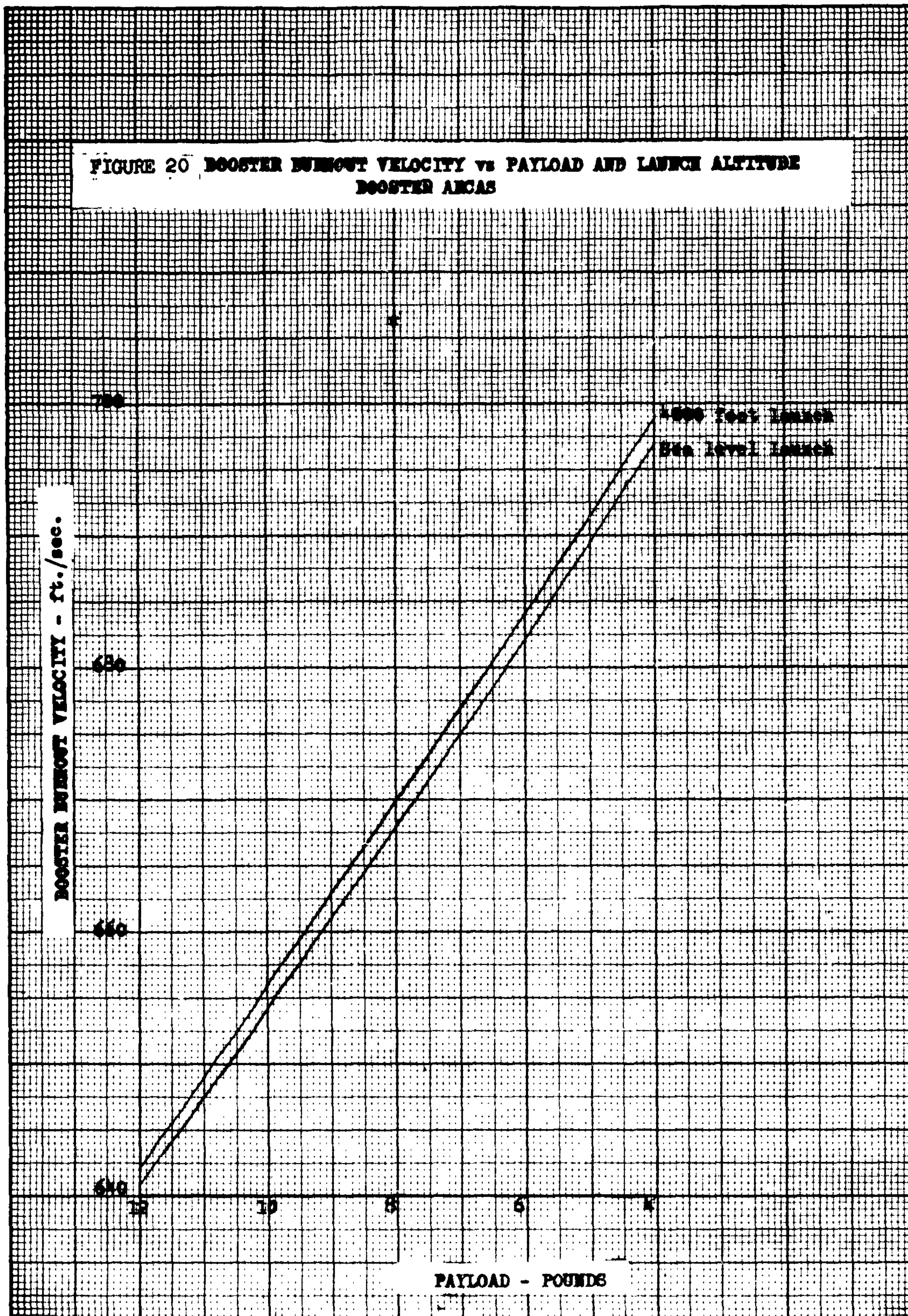
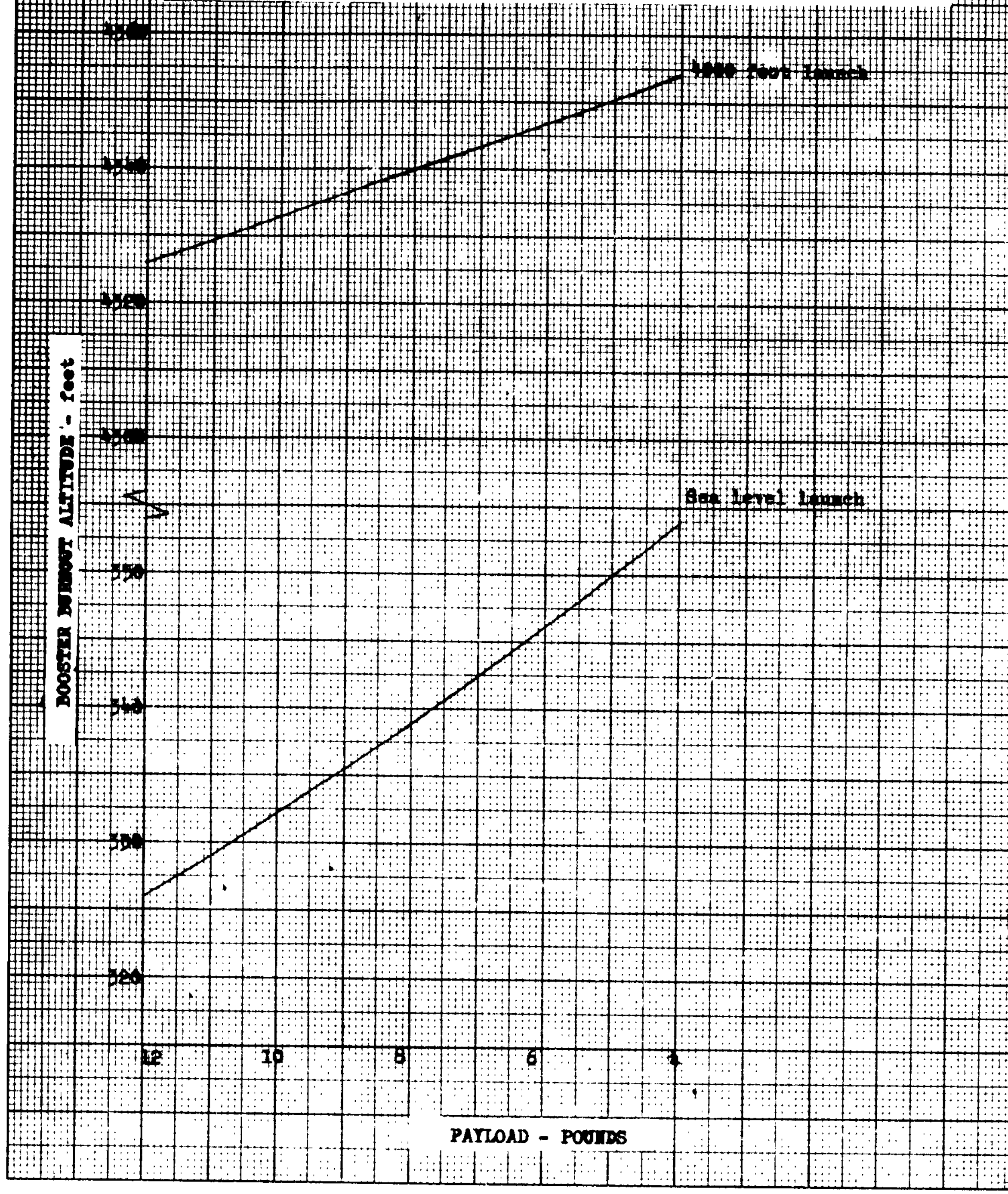


FIGURE 20 BOOSTER BURNOUT VELOCITY vs PAYLOAD AND LAUNCH ALTITUDE
BOOSTER ARCAS

FIGURE 21 BOOSTER BURNOUT ALTITUDE vs PAYLOAD AND LAUNCH ALTITUDE
BOOSTED ARCAS



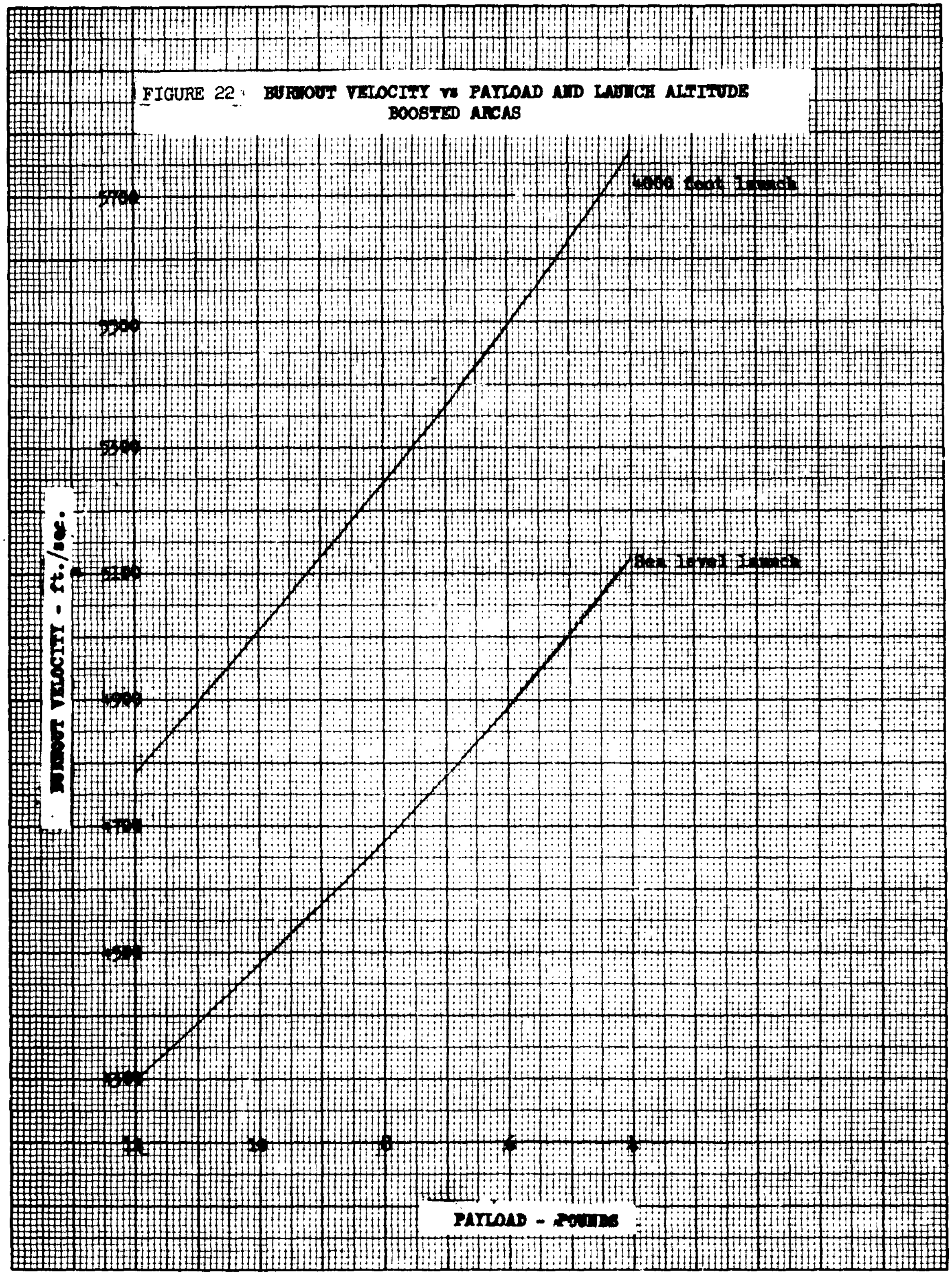


FIGURE 22 BURNOUT VELOCITY vs PAYLOAD AND LAUNCH ALTITUDE
BOOSTED ARCAS
4000 foot launch
Sea level launch
BURNOUT VELOCITY - ft./sec.
5100
10
8
6
4
PAYLOAD - POUNDS

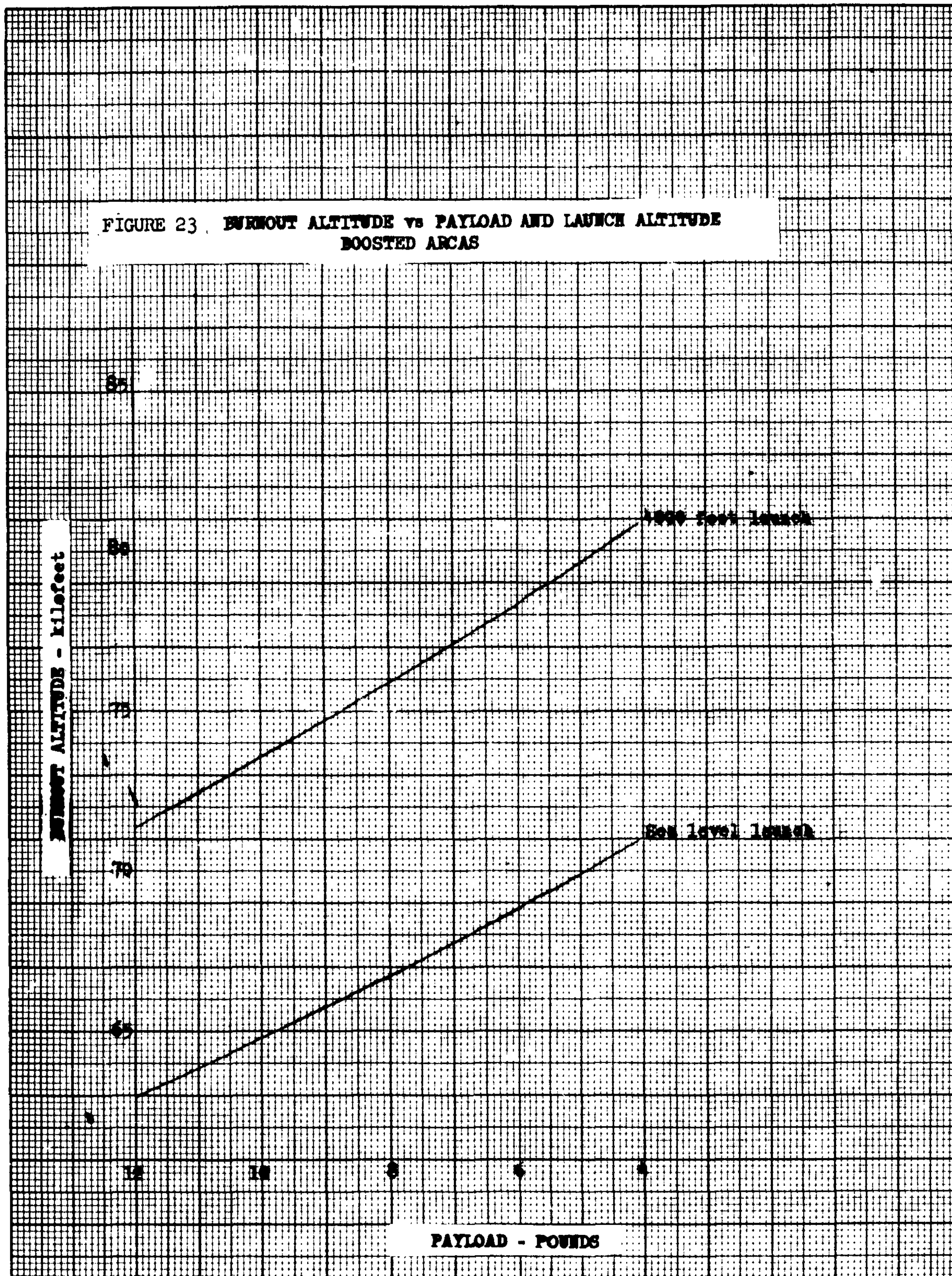


FIGURE 23 BURNOUT ALTITUDE vs PAYLOAD AND LAUNCH ALTITUDE
BOOSTED ARCAS

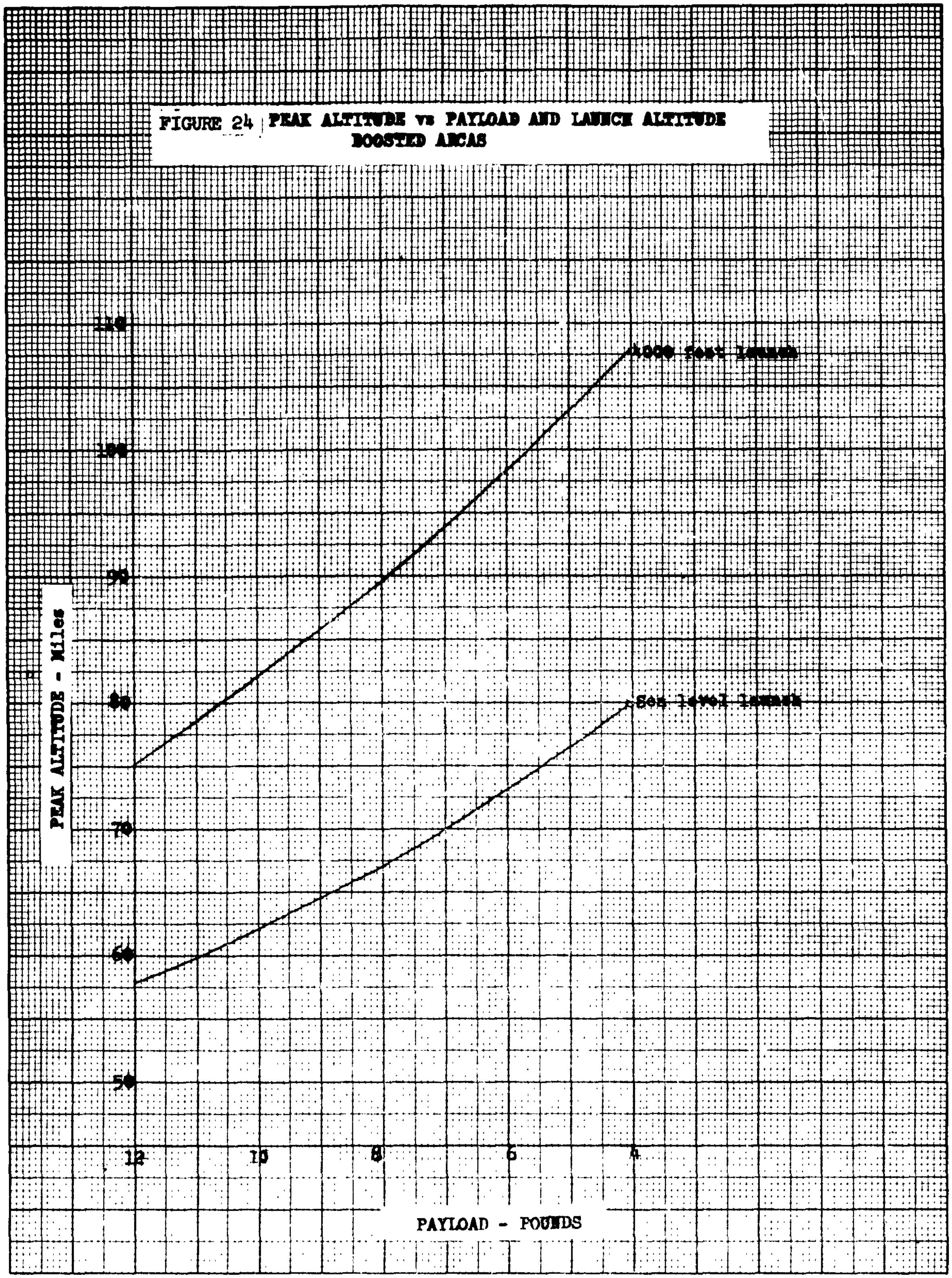


FIGURE 24 PEAK ALTITUDE vs PAYLOAD AND LAUNCH ALTITUDE
BOOSTED ARCAS
4000 feet launch
Sea level launch
PEAK ALTITUDE - Miles
110
100
90
80
70
60
50
12
10
8
6
4
PAYLOAD - POUNDS

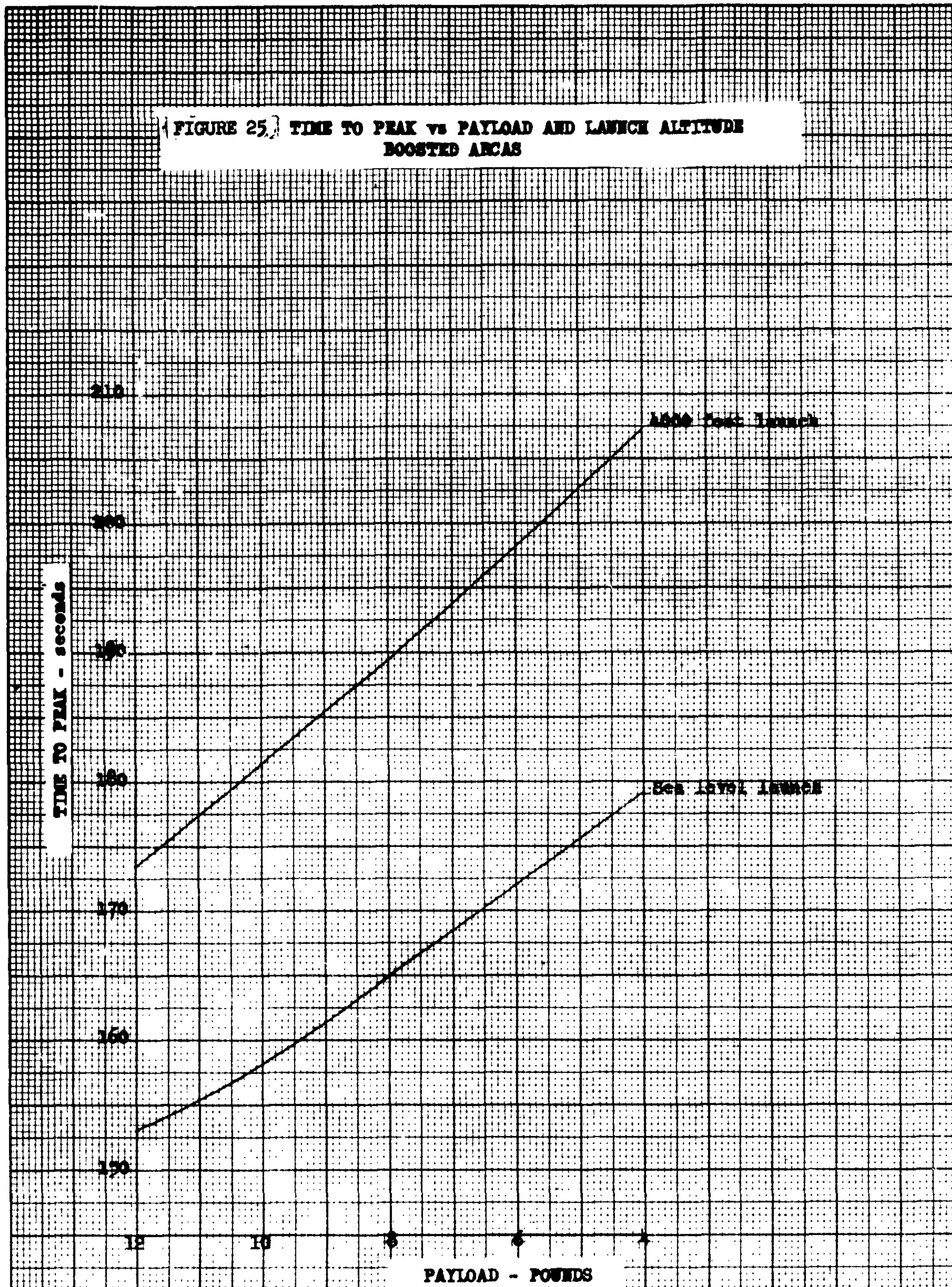
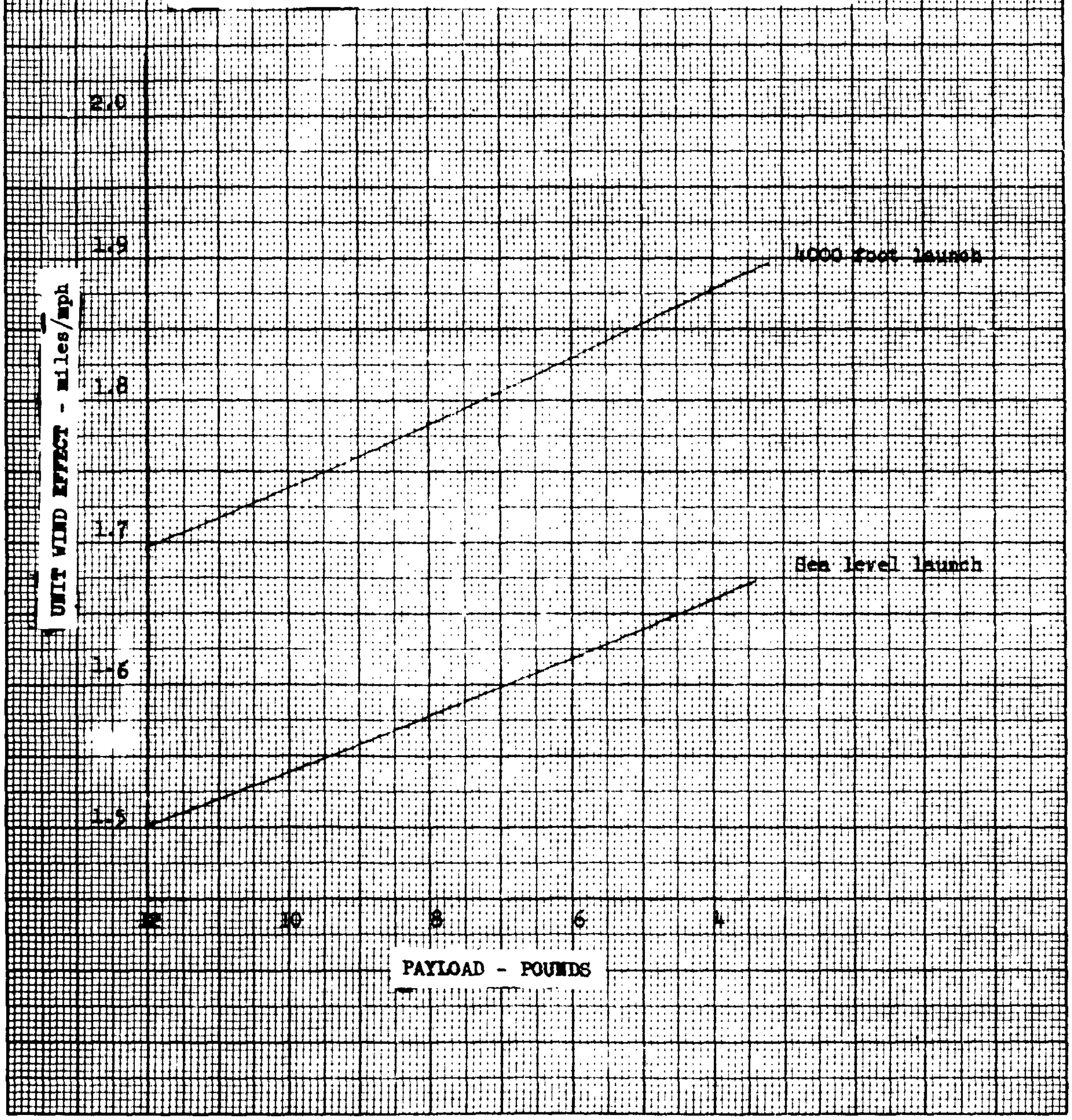


FIGURE 25 TIME TO PEAK vs PAYLOAD AND LAUNCH ALTITUDE BOOSTED ARCAS

FIGURE 26 UNIT WIND EFFECT vs PAYLOAD AND LAUNCH ALTITUDE
BOOSTED ARCAS



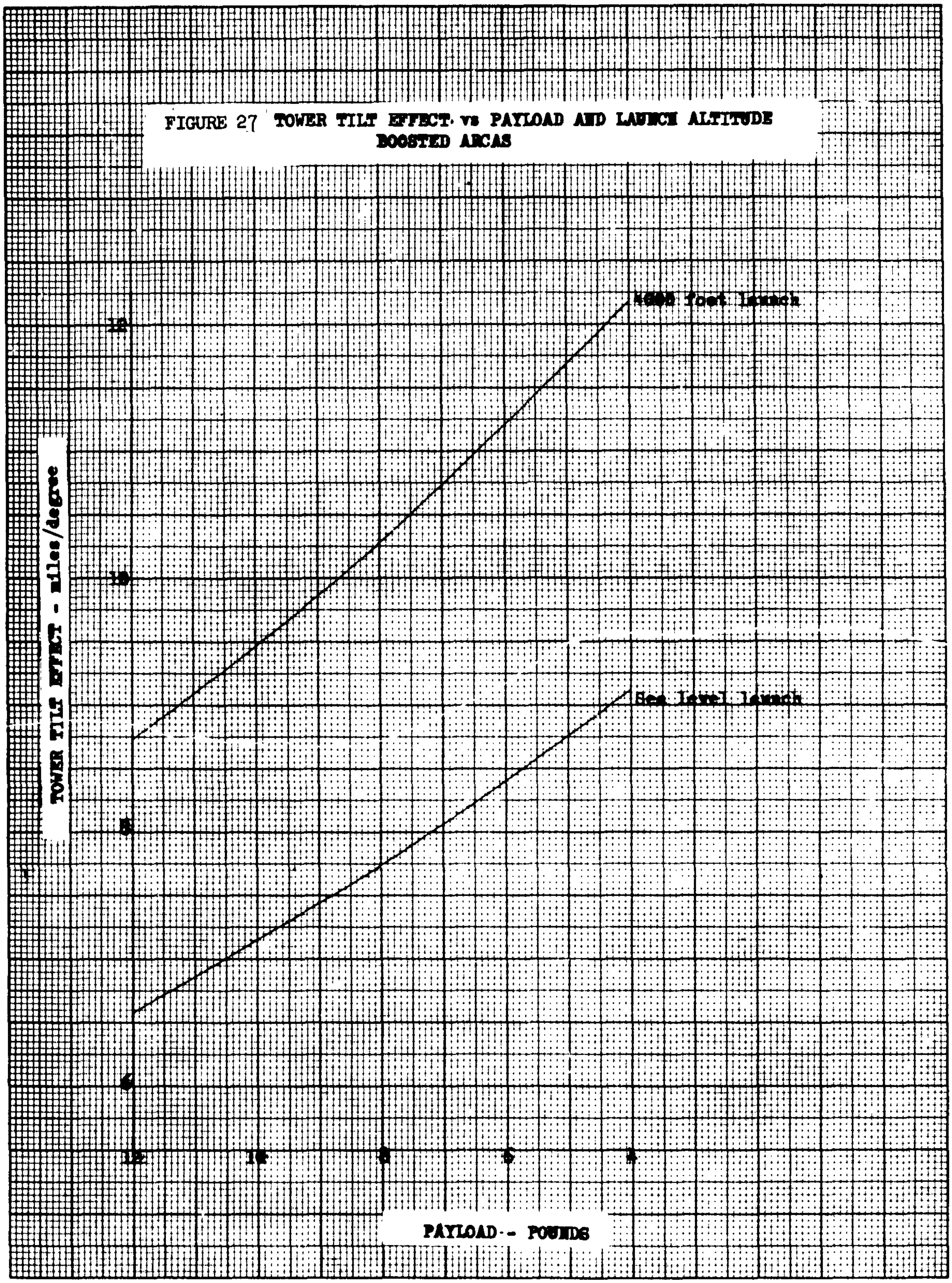


FIGURE 27 TOWER TILT EFFECT vs PAYLOAD AND LAUNCH ALTITUDE
BOOSTED ARCAS

REFERENCES

1. Webb, W. L. and K. R. Jenkins, "Flight Testing of the Arcas, Technical Memorandum 623," Missile Meteorology Division, U. S. Army Signal Missile Support Agency, White Sands Missile Range, New Mexico, May 1959.

2. Duncan, L. D. "Revised Ballistic Standard Atmosphere for White Sands Missile Range, 1957-1959, Technical Memorandum 751," Missile Meteorology Division, U. S. Army Signal Missile Support Agency, White Sands Missile Range, New Mexico, August 1960.

D I S T R I B U T I O N

Technical Report MM-432, "Theoretical Performance of the Arcas and Boosted Arcas," UNCLASSIFIED, Missile Meteorology Division, U. S. Army Signal Missile Support Agency, White Sands Missile Range, New Mexico, April 1962.

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